THE
ELECTRICAL REVIEW.

VOL. LXII. MAY 15, 1908. No. 1,590.

ELECTRICAL REVIEW.

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(J. A. BERLY'S)

1908 EDITION

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THE ATTITUDE OF THE PUBLIC TOWARDS SCIENCE.

AN interesting pair of anecdotes were related by Lord Dunedin and Principal Griffiths at the last banquet of the Royal Society. It may be remembered by some of our readers that, according to the first tale, a man who had attended a lecture on science overnight was asked by a friend next day what the subject of the discourse had been, and replied that "the speaker did not say." According to the second, the original narrator, a man of science himself, had been expounding at great length to an acquaintance the methods employed for ascertaining the chemical composition of the sun and its atmosphere, and was at last checked by the inquiry, "who cares whether sodium is present in the sun?"

On this foundation, widely different erections of fact and opinion were subsequently based in the *Times* by signed and by anonymous correspondents in their endeavours to explain why the British public is so generally apathetic towards science. It has been said that nearly all science lecturers are unable to make themselves intelligible to their audience, that they deprive an interesting subject of all the interest which properly belongs to it, that their vocabulary is so limited and so lacking in linguistic propriety that the gorge of all literary men rises, and that they are severely to blame for their oratorical shortcomings. On the contrary, it has been said that the average audience at a science lecture is so entirely ignorant of the subject under treatment—and, indeed, of all its preliminaries—that a lecturer has always to devote the greater part of his time to explaining matters which the schoolmaster is supposed to have taught, that when he has done so the majority of his hearers remain in a state of mental fog owing to their intellectual deficiencies, and that, in short, members of the audience care so little for science as to neglect the obvious duty of acquiring a knowledge of the general principles underlying a certain branch of inquiry before listening to what a specialist on the subject has to say upon its modern aspects. In other words, it has been alleged that an audience collects to listen to a lecture on science without actually desiring to form any acquaintance with the subject elucidated—an assertion which has naturally enabled another correspondent plausibly to deny that members of the public would go to the trouble and expense of attending such a lecture unless they were earnestly engaged in the pursuit of knowledge.

The assumption that people attend a science lecture because they are in search of knowledge is frequently, if not generally, fallacious. It is, indeed, wholly erroneous to imagine that the majority of our adult population are in search of knowledge of any kind. The person who attempts to teach them by pen or by word of mouth is guilty of

presumptuous sin. If we may say so, the public run to hear a man lecture, but not a man's lecture, on a certain subject; they go because it is considered "the thing" to do. Hence the chief factor concerned in determining the number of people present at any lecture on a so-called scientific subject is merely the identity of the lecturer. If the lecture is to be delivered by a man prominently before the public in virtue of his official post or his position at Court, the persons who happen to be leaders in all local affairs, especially social affairs, consider it their duty or privilege to attend; and when the leader points the way, all others follow. Mixed feelings of self-satisfaction due to toadyism and condescension suffuse the bosoms of those who have been brought into brief contact with so eminent a person as, say, the Physicist Royal, quite irrespective of whether he has been discussing politics, science, or art. A man of no renown outside his immediate circle may be, and very probably is, a far better lecturer than the Physicist Royal; but he may expound a most interesting subject in a most interesting fashion on some future occasion, and, as a result, will be shown the courtesy of empty benches.

On the other hand, it is undoubtedly true that many men of science are incompetent lecturers, though it is difficult to see why that fact should be deemed disgraceful. The equipment of a successful lecturer comprises several things which are not requisite in the equipment of a man of science, and a few which are even antagonistic. The successful lecturer must be a man of agreeable presence, of clear musical voice, of well trained diction, a man of ready wit, quick to play upon the passing prejudices of an audience. He must, indeed, be a man who can assume the mental attitude of his audience, unconsciously realising how little they know, from what standpoint they approach any question. The equipment of a man of science comprises extreme concentration of thought, a logical habit of mind, imagination, it is true, but a scientific way of looking at things which, in course of time, wholly estranges him mentally from his fellows. A man's success as a politician largely depends upon his success as a lecturer, because, unless he gain the ultimate position of a constructive statesman, his eminence or notoriety is largely due to his ability to reflect or reinforce the bias existing amongst the people. The politician addressing a meeting is sure of a welcome, or what, in the present connection, amounts to much the same thing, an actively hostile reception, because he deliberately sets out to flatter his audience, explaining to members of his own party how enlightened they really are, and assuring his opponents that their opinions are worthy of criticism. The man of science is called upon to teach, to tell his audience that they know nothing; the *rôle* must, therefore, always be thankless, and the speaker expect to meet with the chill of silent resentment. An intellectual snub received from the Physicist Royal may, perhaps, be something of a compliment; but, proffered by a mere university extension lecturer who has the gift of lucidity, it becomes a deliberate insult. On the whole, therefore, it seems as unfair to expect a man whose devotion and qualifications have enabled him to attain eminence in his particular sphere to retain or acquire the qualifications indispensable in the lecturer, as to expect that every man who can lecture clearly, interestingly, and humorously on a scientific subject should be one of the most prominent exponents of that subject. Broadly speaking, with one or two extraordinary exceptions, the more distinguished a man is as an investigator, the less likely he is to be a clear lecturer, and *vice versâ*. Accordingly, as long as those estimable persons who consider it their duty to arrange so-called popular lectures on science, exhibit the modified form of snobbishness characterised by the retention of a leading investigator to teach the A B C of any subject to an indifferent audience, so long will the results cause the earnest student to grumble, and the literary purist who thinks that a split infinitive, or the creation of a hybrid word is a sign of mental, if not moral, obliquity, to sneer. By way of parenthesis, it must be added that since scientific research occasionally results in the acquisition of fresh knowledge, new words have to be coined to describe the new substances or phenomena observed. This is, doubtless, most unfortunate, for it annoys the printer and the lexicographer quite as much as the philologist; but, perhaps, some of us may think that the crime of adding a bastard word to the English language is honourably wiped out by having studied the fact or idea that it is intended to convey.

Price Reductions in Germany. It will be recollected that during the course of the period of high prosperity, in 1906 and in a portion of 1907, the German electrical firms made various increases in the prices of dynamos, motors, transformers, &c., as was recorded in this journal at the time. The advances, which eventually reached a total of 20 per cent. on the list quotations, were effected by the Association of electrical firms, which comprises the majority of the manufacturers in that country. Apparently the few firms remaining outside the Association followed the augmentation individually, especially as they were equally affected by the rise in the rates for raw materials, and in particular those for different metals. But with the gradual decline in the demand for electrical manufactures, the outside firms discontinued the increase over the list prices, and a proposal to drop the 20 per cent. addition was brought before the Association also, but was rejected. Recently, however, the question was again brought before the Association, when it was decided no longer to allow the 20 per cent. excess "to be visible." This has implied the preparation of fresh lists, in which the sale prices appear only as individual figures. As the Association does not regulate the basis prices, but leaves them for the works severally to fix, it will be seen that customers have no idea now as to whether any, and, if so, what, amount they are still being charged over the original quotations existing prior to the gradual increase up to 20 per cent. over the listed rates. The development of the matter in recent months is, however, said to have led to the conclusion that the 20 per cent. increment has been abolished in practice as a general rule.

Cheap Cables. "The World's Cables and the Cable Rings," is the title of an article by Mr. John Henniker Heaton, M.P., in the *Financial Review of Reviews* of this month. A criticism of the present Postmaster-General is contained in a P.S. stating that he is not to blame for the absence of "penny" telegrams, because his time has been fully occupied up to the present in dealing with internal postal troubles. This cannot be said to be soothing, and to old "telegraphers" the sign has been writ large for many years that such troubles would come sooner, and not later. A quarter of a century to many of them who have advocated Imperial cables is not very long for a Government question; many of us are hopeful that the subject may not die, and although there has not been—says Mr. Henniker Heaton—any Imperial Postmaster, he will admit also that there has been no Imperial purse in the proper sense of the term. Sums have been given out, but in such driblets and often useless quantities, that penny telegrams are as far off to-day

as ever, and the acquisition of cables by the State, by which means such an arrangement could best be arrived at, just as much advanced as 25 years ago; in fact, there seems to be little Imperial instinct, much less reason left so far as this industrial undertaking is concerned. "Wireless" has threatened the present form of telegraphy. To-morrow conditions may be different, but at least let us work with the proved system to-day, and not pay for another until it has proved better than the one we have. The Empire makers say that "wireless" is the method to be adopted, and this "red herring" stops the path of cable progress, and "pennygrams." There cannot be any objection to a "pennygram" where there is a line not fully occupied with other more remunerative work. That there are cables which could be well occupied with such work is too obvious to mention, and the difficulties applying to the conduct of such traffic have been talked of for 25 years. It is obviously such a boon that it passes the wit of man to understand why it is not secured. The total capital invested and the map — reproduced by permission from the Colonial Office List—are not up to date, and in many cases incorrect.

Recent Developments in the Gas Turbine.

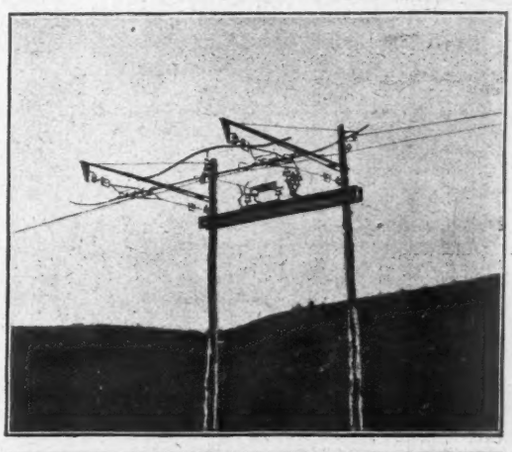
While the steam turbine is still passing through a more or less experimental stage, the gas turbine has begun to receive attention, and its more recent developments are described by Mr. Alfred Barbegat in *Cassier's Magazine*. He first describes an apparatus of the De Laval type, worked by the products of combustion of liquid hydrocarbon burned in a pear-shaped combustion chamber with the assistance of compressed air. Expanding nozzles deliver the products of combustion upon the wheel. In such an apparatus it is necessary to deliver so much air under compression into the refractory chamber, and this air is increased in volume in the ratio of its absolute temperature before and after combustion of the charge. The temperature of combustion is 1,800° C., and carborundum appears to be the best refractory substance with which to line the combustion chamber. Carborundum has already been produced at a temperature above that of the combustion it encloses. A water jacket is also needed to preserve the metal of the combustion chamber, and some of the jacket circulation water is delivered into the gases just as they are about to enter the nozzles. The gas temperature is thus lowered, by the formation of steam, to a point where the blades of the turbine will not be injured. Thus the working jet consists of steam and the products of combustion of the fuel. Obviously, to preserve the rotary idea throughout, the air employed must be compressed by a form of rotary compressor, and this should have a good efficiency of itself, or otherwise its negative work will be excessively great. Prof. Rateau designed a multiple turbine compressor for the work, and it was built by Brown, Boveri & Co., of Baden. It is in three sections, with continuous cooling circulation, and was claimed to have delivered one cubic metre of air per second at 6 to 7 atmospheres with an efficiency of 60 or 70 per cent. It absorbed half the total power given out of the machine when developing 300 H.P. at 4,000 revolutions per minute. Thermal efficiency tests show that, so far, the gas turbine is less efficient than the reciprocating gas engine. A number of experimental gas turbines have, it is said, already been installed in submarine torpedoes for active service; they develop 120 H.P.

There appears some prospect, therefore, for the future of the gas turbine—at any rate, for certain purposes. Unfortunately for thermal efficiency of a high order, the great reduction of the temperature of the freshly-burned charge of fuel and air, by the injection of water-spray, is not calculated for any purpose but that of preserving the rotor wheel. Really the gas turbine is converted into a steam turbine with the fire inside the feed heater and the boiler and superheater common with the furnace. The subject certainly is interesting, but we fear that the compression of the air will always prove somewhat of a difficult problem for the gas-turbine enthusiast.

THE ROMA-CIVITA-CASTELLANA SINGLE-PHASE RAILWAY.

In our issue of June 2nd, 1905, we published an account of this line—the first of its kind on the Westinghouse system in Europe—which was then under construction; it is now in successful operation, with great benefit to the resident population, the district having previously been entirely without transportation facilities. The passenger traffic is carried on by means of seven single-truck cars (fig. 4), each equipped with two 40-H.P. commutator type single-phase motors, with drum controllers; on the interurban service each motor-car hauls a trailer, the total weight of the train being 20 tons. On the city service, trailers are not used. There are also two locomotives for freight traffic, each equipped with four 40-H.P. motors, and weighing 20 tons; these are controlled on the Westinghouse multiple-unit system, and are capable of hauling a 75-ton train, including

Fig. 1.—Section Switch.



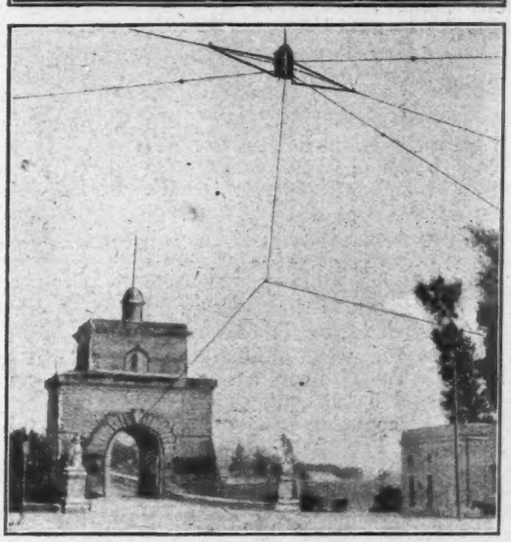


Fig. 2.—Trolley Crossing in Position.

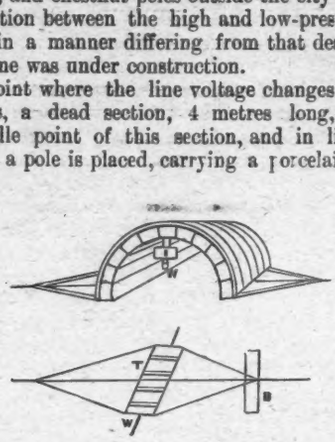
the locomotive, on a 3 per cent. gradient. The locomotives and motor-cars are equipped with the Westinghouse pantograph trolley and air-brakes.

The line construction was carried out by Messrs. Bisson Bergés, of Paris, with round trolley wire of 66 mm². cross-section on the city route between Rome and the power house, which is operated at 600 volts, and is 5 km. in length; there are no feeders at present, though owing to the increasing traffic it will shortly be necessary to provide one. The route between the power house and Civita Castellana is operated at 6,600 volts; a figure-8 wire of 50 mm². cross-section is used here. Double insulation is employed throughout, of porcelain and ambroin on the low-pressure

section, and of porcelain elsewhere. The line is supported by bracket-arm construction, with iron poles on the city section, and chestnut poles outside the city (fig. 5).

The junction between the high and low-pressure sections is effected in a manner differing from that described by us when the line was under construction.

At the point where the line voltage changes from 600 to 6,600 volts, a dead section, 4 metres long, is inserted. At the middle point of this section, and in line with the other poles, a pole is placed, carrying a porcelain arm which



W, D.C. trolley wire; I, Ambroin insulator; T, Pantograph trolley.

FIG. 3.—ARRANGEMENT OF TROLLEY CROSSING.

throws the change-over switch on the car as it passes. This switch, which is placed on the roof of the car, is a two-way switch, having one terminal connected to the base of the pantograph, and the other two connected to the 6,600-volt and 600-volt terminals respectively of the auto-transformer. In passing over this section it is not necessary to lower the trolley, as no current is on the car when the switch is thrown.

As catenary construction is not employed, it was necessary, in order to satisfy the Government engineers, to find a sure means of protection against the live end of a broken wire. To meet this requirement, a small wire was connected to the trolley wire at the end of the line in Civita Castellana and brought back on the pole line to the power house. Here it was connected to one terminal of the primary of a shunt transformer, the other terminal being earthed. The secondary is connected to an electro-magnet mounted on an oil switch, which is in the circuit of the wire connecting the power house to the trolley line. To put current on the line, the switch is closed by hand; it is then held in by the electro-magnet. To test the operation of this apparatus, a knife switch was put in the circuit; when this switch was opened, the oil switch dropped out immediately, with no perceptible interval of time. In case of a heavy short on the line, the switch will open on account of the drop in voltage. The high-tension line only is protected by this switch, no special protective apparatus being employed on the low-tension section.

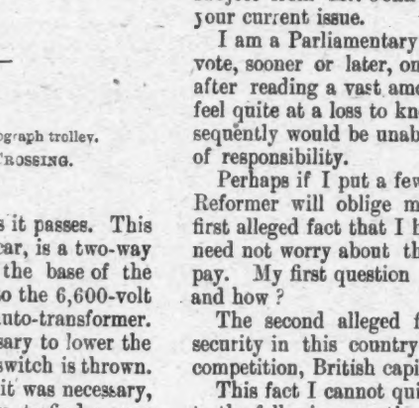


FIG. 4.—MOTOR-CAR AND SECTION SWITCH.

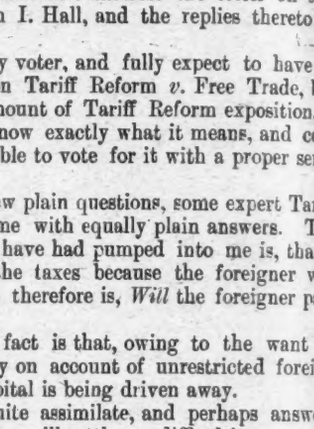


FIG. 5.—TROLLEY WIRE SUSPENSION AT A CURVE.

Close to each station is a section switch, which can be opened from the ground by means of a long wooden stick (fig. 1). By means of this, any trouble in the line can be localised very quickly.

At two points on the low-tension line, a 500-volt direct-current system is crossed. This is done by means of an inverted trough of wooden slats held together by iron straps, in which the D.C. trolley is carried (figs. 2 and 3). The trough is wide enough to allow the wheel to pass freely, but is put in at such an angle that the pantograph goes over without opening the circuit, and cannot possibly touch the D.C. wire.

The local company will purchase energy from a new central station near Ponte Milvio, intended for the lighting of the new quarter of Rome, on the right-hand side of the Tiber. At present power is supplied from Tivoli, as three-phase current at 8,000 volts, 42 cycles, which is transformed by a motor-generator group into single-phase current at 6,600 volts and 25 cycles. Two 1,000 KW. turbo-sets are being installed in the new station by Messrs. Gadda & Co., of Milan.

The city service was opened to the public in October, 1906, and the whole line in December, 1906; since then the traffic has increased steadily. The road is to be prolonged to Viterbo, 40 km. to the north of Civita Castellana.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Placing Orders Abroad.

I have read with considerable interest the letter on this subject from Mr. John I. Hall, and the replies thereto in your current issue.

I am a Parliamentary voter, and fully expect to have to vote, sooner or later, on Tariff Reform *v.* Free Trade, but after reading a vast amount of Tariff Reform exposition, I feel quite at a loss to know exactly what it means, and consequently would be unable to vote for it with a proper sense of responsibility.

Perhaps if I put a few plain questions, some expert Tariff Reformer will oblige me with equally plain answers. The first alleged fact that I have had pumped into me is, that I need not worry about the taxes because the foreigner will pay. My first question therefore is, *Will* the foreigner pay, and how?

The second alleged fact is that, owing to the want of security in this country on account of unrestricted foreign competition, British capital is being driven away.

This fact I cannot quite assimilate, and perhaps answers to the following questions will settle my difficulties:—

Are the foreign imports of this country paid for in coin or in goods?

In what form has the capital which has been frightened away left this country?

Did the capitalist go with his capital? If he did not, does he expect any return for it? And if so, in what form will that return be, *i.e.*, cash or goods?

There are many other questions that one has to have settled in considering important questions like this, but the above are fundamental, and clear answers to them will, I think, be a great help.

Geo. W. Green.

London, S.E., *May 8th*, 1908.

In my previous letter I endeavoured to place in nut-shell form, the basis of our foreign trade.

"W. M. M." says I am wrong. I will request him to show, without padding, that I am wrong. I claim that the school of economics in which I have been trained is right in respect to the method on which our foreign trade is conducted at the present time, and I challenge "W. M. M." to prove that unrestricted trade is otherwise. If he knows anything about the subject, there is an opportunity for him to put his

views clearly and concisely before the commercial men of the electrical and engineering industry who read your paper for profit and edification.

Mr. Fawcett says that the economic aspect of the question which I gave, is new to him. His citation of the trading of A, B, and C is absolutely the basis of our foreign trade, excepting that that trade is more complicated in its ramifications.

We trade with food-producing and manufacturing countries, and we must take in return what they have to dispose of; *what they send us we require and ask for*, and we first require food, then raw materials, afterwards their manufactures to settle up the account.

If Mr. Fawcett will refer to the Board of Trade returns for the past *month of April* he will there find that our exports and imports of manufactured commodities are shown to be as follows :—

Exports of manufactured goods	=	£24,500,000
Imports " "	=	12,600,000
Balance in favour of home manufactures	=	£11,900,000

Suppose the £12·6 million pounds' worth of imported goods had been manufactured at home, I take it that no one will say that by so doing more work would have been found for workmen in our shops and factories. I grant that on the face of it, it looks as if it would, but if the imports decrease the exports also decrease in a corresponding amount, so no advantage is gained in the direction of finding more work for the unemployed.

But a much graver aspect is opened by Mr. Fawcett than he evidently grasps. In his letter he not only acknowledges that he has not grasped the basis of our fiscal system, but, by recommending a tariff on imports so as to increase the price of imported commodities, he suggests the striking of a blow at the very basis of our foreign commercial system which would be absolutely ruinous.

He actually suggests the depreciation of the intrinsic value of our foreign investments!

Such folly is absolute commercial suicide.

Traders, employers, capitalists and financiers have, with earnest and diligent enterprise, brought to our notice the value and advisability of foreign investments.

They have induced British investors to sink their capital in this direction, promising anything from 5 per cent. to 10 per cent. interest and over on the outlay.

The new school of economics (*à la* Birmingham) now advises the depreciation of those investments by putting difficulties in the way of the sale of the commodities which those investments bring to our markets, and which commodities represent 5 per cent. or 10 per cent. return on the capital invested abroad.

Our foreign investments are somewhere in the region of £1,600 millions sterling. I have not the exact figures before me as I write.

Suppose at the lowest estimate we reckon that they bring an all-round interest of 2½ per cent. (2·5 per cent.), this on £1,600 millions = £40 millions sterling per annum. By placing a tariff on those imports, which represent that interest, the effect is to increase the price, and thus restrict the amount of imports, and by so doing depreciate the value of the capital of our foreign investments, decrease our foreign trade, and increase the amount of unemployment in the country.

The value of British foreign investments is at a maximum when the amount of imports is the greatest and when they can be realised in the home market at current prices.

Has it ever occurred to Mr. Fawcett that our foreign investments, *as interest-raising stock, are of the greatest value to the British investor only by the realisation of interest thereon in his home market*, and if he receives no interest he must sell out at a discount, and, with reduced capital, seek reinvestment in a more restricted home market?

What an injustice to the British investor, and what a cruel deception on the electrical industry and on the British industry generally is contained in the recommendation of a tariff on our imports.

I am glad to say I am not acquainted with the institution with which Mr. Fawcett seems to be so familiar, and to which he refers as containing a not inconsiderable number of mentally deficient engineering assistants.

During the past 25 years I have made the acquaintance of a large number of the engineering fraternity, but they were all able to take care of themselves.

But I have heard and seen fiscal fairies spinning fancy illusions around subjects on which they display a most profound ignorance, allowing the reasoning faculties, which should be used for self-guidance, to become subservient to misguided credulity. I would strongly advise any such to take a course of fiscal physic, washed down with commercial commonsense.

The great economic truths upon which our foreign trade is based, have had some shadows cast upon them by the misconceptions of adventurous politicians, but that is no reason why we, as commercial men, capitalists and financiers, and the toilers in industry, should allow our interests to be jeopardised.

The industries of this country have nothing to complain of so long as the imports exceed the exports, as that is indicative of trade being conducted with profit, and of general increase in the wealth of the country.

If the total exports exceeded the total imports, the men engaged in foreign trade and enterprise would soon be bankrupt, and our country filled with the cry of the children for bread.

It is a pleasure to turn from the correspondence on this subject, to the leading article in your current issue, where, instead of depreciating the value and curtailing the extent of foreign trade, with true commercial foresight, you so strongly recommend further developments in directions which have been neglected. I hope every member of the electrical industry will read your article and decide to act on it, make our foreign trade hum to a greater extent than it did even during last year, and utilise the profits therefrom for the further development of our home industries, particularly in traction facilities in districts which are not yet provided, but where they would be of advantage, and in the development of power generating stations, and the hundred and one ways where the profits can be utilised.

As engineers and commercial men it is about time we endeavoured to stem the tide of trading absurdities, one of which I have exposed above, and I think if you were to induce someone more able than myself to deal with this subject in a series of articles, they would be of considerable benefit in clearing away the misconceptions by which it is surrounded.

John I. Hall.

London, W.C., *May 9th*, 1908.

Emergency Brakes.

In the "Correspondence" columns of your last week's issue, Mr. C. R. Everson has, I see, carried out his intention, which he indicated in a letter to me a few days ago, to proclaim generally that I had done him the honour to produce practically a *fac-simile* of a brake invented by Mr. Sleep and himself.

The published description of this brake in the *Tramway and Railway World* may be of interest to your readers, and permit them to draw their own conclusions as to the correctness of this statement. A run-back brake was called for on one of the Plymouth routes by the Board of Trade, and the following was thereupon evolved :—

"The new brake consists of an iron rectangle, about 5 in. wide, running the entire width of the car. It is carried just behind the pair of wheels to which it is fitted, and is actuated by a small wheel on the driver's platform. A quarter of a turn of the wheel sets the levers in motion, and the scutch descends on the track and rails. Any backward motion of the car brings the wheels immediately in collision with the scutch, and the greater their impetus, the greater is the measure of the resistance offered by the scutch, which impinges simultaneously upon both wheels and upon the whole width of the track."

The word "track" is altered in another description to "rail."

This brake is, therefore, of the "scotch" form, of which there are many. This latter may be news to Mr. Everson, and neither can he claim to be the originator of this kind of brake.

E

His brake, according to the descriptions, clearly acts on the surface of the rail, and there is no reference whatever to the use of the groove as a braking surface. Run-back scotch brakes similar to his have proved by no means satisfactory; possibly his experience may be different.

Leaving the construction of the brake, the range of its operation might now be considered. His is a run-back, hand-applied brake, while mine is an instantaneously applied emergency brake, capable of dealing with tramcar braking under any condition, and at any speed. Here again his statement that my brake is a *fac-simile* of his is an unfortunate one.

I notice that a few days after his official tests, which were of a public nature, a provisional patent was applied for, but it was never completed. One is inclined to ask, why not? And particularly so after the attitude Mr. Everson now takes up. It may, however, be some consolation to him to know that his position has not been prejudiced thereby.

My researches into the action of braking by means of the groove have been very extensive, and are being applied to all classes of braking. I hardly think Mr. Everson should have jumped to the hasty conclusions that he has, for the purpose of depreciating my work in this direction.

I have been interested in reading the criticisms of your correspondent "Brake," and I should like to have the opportunity of replying to them.

Your Editorial note to the effect that my brake is an emergency brake is a general answer to these criticisms. Although an exceedingly hard material, which has been the subject of much experimenting, is used as a braking surface acting in the groove, and in addition a very high pressure per square inch between the operating surfaces is utilised, yet the amount of abrasive action on the groove would not cause any appreciable wear, even if the brake were frequently in use.

I might say that one of my grades of 1 in 12 has had some 300 or 400 emergency stops made in the groove over a long period of time, without any appreciable effect.

The groove of the tramway rail is certainly not designed to deal with any specially severe stresses beyond flange action, but when one remembers the length of area over which the strains from my brake are distributed, I think there is no reason to anticipate that the rail is not amply strong enough. Certainly, in the numerous experiments that have been made, nothing has occurred to warrant a different assumption.

Your correspondent, "Brake," refers to a design of skid brake, in which the skid acts on the tread of the rail, and the under side of the skid has a file-like surface to ensure a grip on the greasiest rail, and he says that in his opinion such a brake will be as effective as mine without the disadvantages which he believes may occur. I note, however, that it has not yet been put into operation, and I should be interested to hear what results can be obtained with it.

I am strongly of the opinion that such a form of skid brake would have the same defect inherent as with others that have been tried, which is, that it is only effective at quite slow speeds, and that if applied at anything above this, the coefficient of friction is too small to be of much value, and the car gets out of hand.

The roughened surface of the skid would, I am afraid, after a very short run lose its grip on the polished rail tread, so that the conditions would be approximating to a skidded wheel.

P. J. Pringle.

Electricity and Tramways Department,
Burton-on-Trent, *May 8th*, 1908.

Reform Wanted.

In the course of my travels recently, I have come across many stations, some owned by Corporations and some by public companies, where the plant, although good when it was installed some years ago, is now out of date as to both size and efficiency. I have not found much difficulty in many of these cases in convincing the engineers that by installing new plant an enormous saving could be effected, but one is always up against the question of capital expenditure.

In the case of companies, they probably have not the money, and find it difficult to raise it; but in the case of Corporations, the Local Government Board would insist upon the plant which was replaced being written off the books after it was scrapped.

It seems to me, therefore, that in view of the enormous strides that have been made in the generation of current within the last few years, some provision is required in the case of Corporation stations by which the Local Government Board would sanction the clearing of the old plant from the site and the installation of new, permitting the Corporations to borrow new capital, to be repayable over shorter periods, say, five or six years.

In one particular case, that of a fairly large station where 700 or 800 KW. more is required to be installed, and where there is a very good load factor for power purposes, the expenditure of about £11,000 would ensure a guaranteed saving of over £2,000 a year.

By carefully analysing the costs and conditions of supply of many other stations, I find that there are many cases in which a similar process would make all the difference between commercial failure and success. It is a somewhat striking proof of the danger of municipal trading that so many Corporations should now be landed in a position where they are absolutely prevented from supplying current to the public as cheaply as it could be done, if they were not handicapped in the manner stated.

Surely the only *raison d'être* for municipal stations, is that they should supply that portion to the public for which they have an exclusive right to cater, on as favourable terms as possible in the interests of the trades of the district, but this must not be effected at the cost of the ratepayers, as it is fundamentally unsound.

The only objection that I can see to the Local Government Board sanctioning such short loans is that it might be argued that the plant so purchased may itself become comparatively obsolete within the period allowed, but I think there is very little force in this argument if the period is made reasonably short, as suggested.

After that period has expired and the whole capital is repaid out of profits, it is obvious that current could be supplied extremely cheaply, probably, in fact, as cheaply as it could be done by any newly discovered plant that could be installed.

My remarks have special reference to the installation of Diesel oil engines for day loads, light loads, and overloads in existing steam stations, and in view of the trend of modern opinion in regard to internal combustion engines, and particularly the Diesel, I think very few people will be found to say that the installing of such engines would be open to the criticism as to their becoming obsolete within the period suggested.

Thos. Browett.

London, E.C., *May 11th*, 1908.

British Electrical Enterprise in Spain.

I was much interested in your leading article on the above, in the course of which you say: "The National Electrical Manufacturers' Association might more appropriately concern itself with the suggestion."

Shortly after the publication of the Consular report to which you refer in your article (*i.e.*, some months ago), I wrote to the N.E.M.A. calling their attention to the report in question, and making suggestions as to their following it up. Up to the present moment I have not even received an acknowledgment of my letter, and I thought it probable that in the opinion of the N.E.M.A. there was so much work of a highly remunerative nature to be obtained in this country at the present moment, that it was not worth while to bother about export work.

Mañana.

Electrical Trade with Canada.

Your issue of the 1st inst. reproduces an article by Mr. Athol G. Evans, of Boston, U.S.A., upon the report of Mr. Richard Grigg, Board of Trade Commissioner, upon British Trade with Canada. The article, although admirable in

regard to the particular and important trade with which it deals, opens with an expression of opinion that the Commissioner has by no means arrived at the true solution of the method for increasing British trade with Canada. But the writer seems to have overlooked the fact that British trade with Canada is not confined to electrical manufactures, and that the remarks to which he refers apply to the whole trade and not to a part of it. There appears, further, to be some evidence that Mr. Evans has written on the basis of your leader, which naturally dealt with electrical matters, rather than upon the basis of a careful reading of the report itself, for in that document he will find (page 54) the very argument as to branch works in Canada which he uses in unfavourable criticism of the report.

It would appear that the solution suggested by Mr. Evans is almost exactly the same as that indicated by the report, and we have the curious and interesting result that Mr. Evans in effect expresses the opinion that the solution recommended both by the report and by himself is not the true solution.

Britisher.

"PAY-AS-YOU-ENTER" CARS.

By A TRAMWAYS ENGINEER.

A certain device in street traction work, designated by the above description, has been recently illustrated and described in the columns of the Electrical Review. The International Railway Co., of Buffalo, United States, have placed 50 of the new Stephenson semi-convertible cars on their lines, and it has been suggested that such cars should be adopted on this side of the Atlantic. Owing to this suggestion it is worth while considering one or two points in connection with the use of pay-as-you-enter cars, generally considered, which may largely determine the value or otherwise of this system of equipment in Great Britain.

The system necessitates the conductor remaining on the front platform in order to collect fares. This is no drawback in the United States of America and other countries where the system is adopted of charging a uniform fare, since once the conductor has received the fare the passenger is at liberty to alight at whatever stopping point he pleases. The difficulty, however, in the case of graduated fares is obvious; the passenger may pay the fare for a short distance, and if he is unscrupulous may travel beyond it, trusting that the conductor may not observe him.

Judging from the difficulty which is even now experienced with the ordinary double-deck cars during crush hours, in assuring that passengers do not overstay their welcome, it can easily be seen that the difficulty in a "pay-as-you-enter" car of the double-deck type would be so accentuated as to lead to an inclination to fraud. A modification, however, that certainly might be tried on English tramways, is the arrangement of a front entrance and rear exit, as this offers several conspicuous advantages. First of all, more than half the time at present wasted at stopping places would, on an average, be saved, since there would be two doors in use, and there would not be that greatest cause of delay, the attempt of passengers to board a car at the same time that passengers are attempting to get off. The conductor would only have to deal with streams of passengers moving in the same direction. Another advantage would be the abolition of over-crowding of the rear end of the car with short-distance passengers, which very often nowadays gives the appearance to a single-truck car of sitting on its haunches. Moreover, the motor-man would be in a position to assist the conductor in the case of excessive crushes, avoiding crowding of the car by keeping the entrance closed.

The principal disadvantages which would occur in the use of this method would be due to the passenger himself. There is a type of man who insists on boarding cars in motion, and this individual will run greater risk of falling under the wheels if he attempts to mount at the front end. The elimination of this class of passenger would, of course, be a great advantage in the long run, but there appears to be a popular prejudice against the method of using the car-wheels for this elimination process. Moreover, there is a passenger who insists on getting on or off a car in the manner most suitable to himself, regardless of all rules. This type of man is very often found on the coaches of the Metropolitan Railway, and is the man who will board the railway coach at the centre instead of at the ends and *vice versâ*, regardless of all rules. This type of man, attempting to board a car having an entrance at the front and exit at the rear, would constitute a considerable source of annoyance to the conductor by impeding other people. Another disadvantage is the fact that four gates would have to be fitted to the car instead of two as at present, and in the case of double-deck cars more particularly, the end platform would have to be slightly enlarged. It must, however, be remembered that in many of the newer types of car the motor-man has even now only a small space of the front platform reserved to himself, while passengers are allowed on the remainder. There should not be much difficulty, therefore, on many tramway systems in giving the method of separate entrance and exit a thoroughly good trial. The advantages it offers are surely great enough to warrant the trial of the experiment.

PARLIAMENTARY.

London and District Electric Supply Bill.

(Thursday, May 7th.)

Lord Cromer's Select Committee of the House of Lords commenced the consideration of the Bill promoted for the supply of electricity in bulk to London and district on Thursday of last week. The Hon. J. D. Fitzgerald, K.C., together with Mr. Talbot, K.C., and Mr. Thomas appeared for the promoters. The opponents to the Bill include the L.C.C. (Mr. Lewis Coward, K.C.), the City of Westminster (Mr. Blennerhassett, K.C.), London Electric Supply (Joint Committee Bill) (Mr. Cripps, K.C.), City Corporation (Sir R. Littler), Kensington and Knightsbridge Electric Supply Co. (Mr. Bush, K.C.), and a number of local authorities.

Mr. Fitzgerald asked that the Committee should hear all the evidence as regarded all three Bills—the London and District Electric Supply, the London Electric Supply, and the London, Westminster and Kensington Electric Supply—before giving their decision in either case.

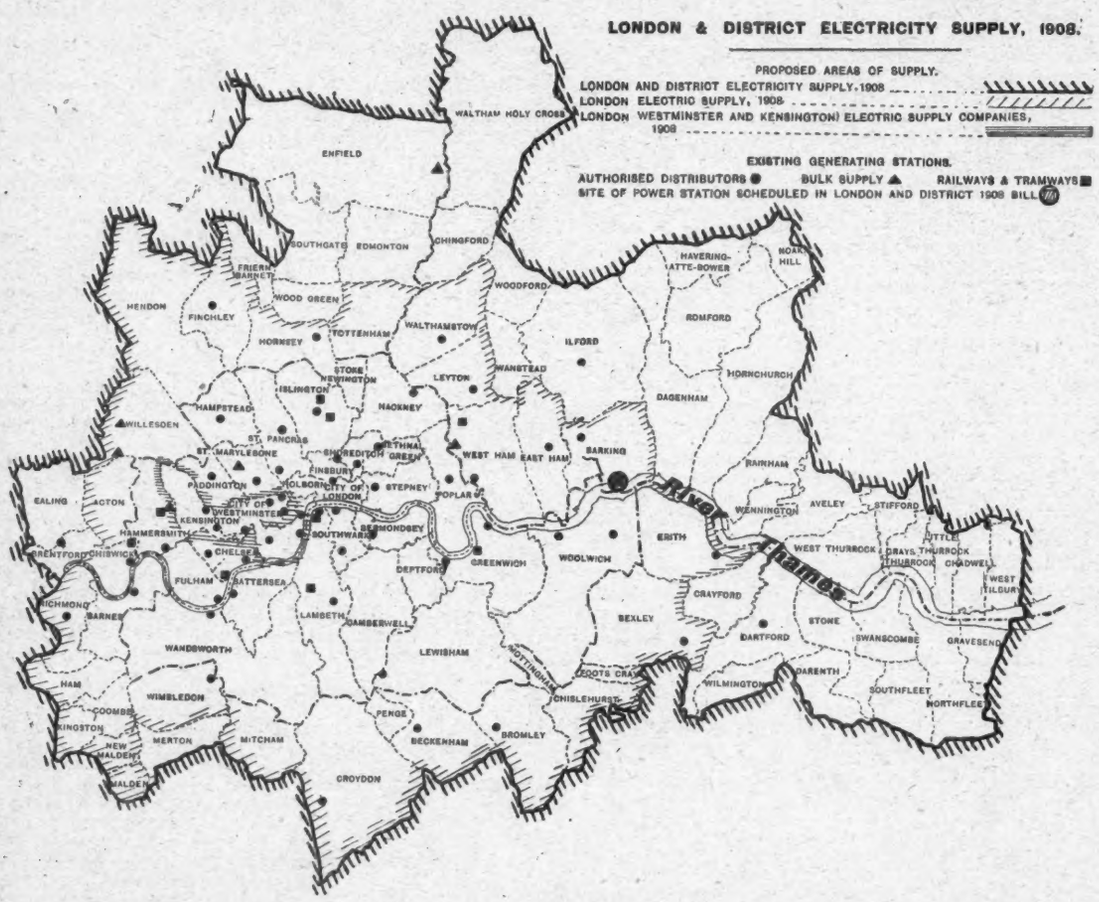
Mr. Balfour Browne, K.C., objected to this, and it was left to the Committee's discretion.

Mr. Fitzgerald, K.C., in opening the case for the promoters of the London and District Bill, said that the Bill was to incorporate a company, and to authorise such company to construct a large generating station at Barking, in Essex, and to supply electricity in a large area comprising the whole of London and the adjacent districts in Essex, Kent, Surrey and Middlesex. The supply intended to be given was—first, a supply to authorised undertakers in bulk; and, secondly, to give a supply for power purposes. The present scheme was an attempt to settle the London power question on workable business lines and to profit by the experience of previous years. The Bill of the present promoters of the Administrative County was very similar to the Administrative scheme of 1905, which passed all but the final stage. There were in London 16 local authorities and 13 companies, all supplying electricity from their own stations. The promoters would be able to give a supply which would enable a manufacturer to have his works practically in the country, so far-reaching was their area. The one large station they proposed would enable the promoters to give a supply throughout the whole area, which included the whole of the Metropolitan area and Enfield, Waltham Cross, Ilford, Romford, Hornchurch, Rainham, Stifford, Grays Thurrock, West Tilbury, Gravesend, Northfleet, Darenth, Wilmington, Bexley, Chislehurst, Bromley, Beckenham, Croydon, Merton, Malden, Kingston, Richmond, Ealing, Willesden, Hendon, Finchley and Southgate. There were at present 66 generating stations, 29 different systems of generating, and 18 different systems of supply. The proposed site was situated on the Thames; they could get coal in abundance, and plenty of water, and they intended to produce electricity on a large scale. Electricity must be produced on a large scale and under such surroundings as would enable the actual cost of production to be reduced to a minimum. Not one of the present companies or local authorities was giving a supply as cheap as what was proposed by the promoters. As an instance of what could be saved in capital expenditure, counsel remarked that the average capital cost per kw. of a company was £47·5, and the local authorities £34·2, an average of £40·85 per kw., whilst his clients estimated that they could install a kw. for £10 or £12. The company would be able to give a bulk supply to interested parties. The whole of the Bill was purely optional for the existing undertakings to take a supply just according to whether they required it or not. No local authority or company was bound to take a supply. There was no doubt that the demand for electricity throughout London was on the increase. Further, they would be able to provide electricity for railways. At present, if a company wanted to run their trains by electricity, they had to erect their own station, as no existing electrical company could give a supply on advantageous terms. The Central London Railway, and the City and South London Railway, among others, had had to erect their own stations. If there had been in existence such a company as the promoters proposed, that would have been obviated. The only exception was that of the London and Brighton Railway, who had a contract for the supply of current for the working of a suburban line from the London Electric Supply Co. The Committee would hear from the representatives of railway companies that one of the matters which deterred them from working their suburban traffic by electric current was the very large capital expenditure which was involved in setting up a generating station for their own purposes.

The Chairman: Are the companies represented here by counsel?

Mr. Fitzgerald: I do not think so—they are not opposing at all. The London, Tilbury and Southend Railway appear with reference to one of the clauses. The effect of the Bill is to give them an option which they do not at present possess; it does not interfere with them. Continuing, counsel said that as a matter of fact he would call representatives to show that they regarded the Bill with favour, as it gave them an opportunity of asking for a supply if they required it. A company on the Tyneside was at present supplying the North-Eastern Railway with current for the working of a suburban railway 27 miles in length, and as they were able to get the electricity at a low rate they were able to

work the line in a satisfactory manner. The third point was that they would give a supply to power users. There was no doubt that there was an immense field for the supply of power at cheap rates. There were a very large number of manufacturers and others who got their power from a steam plant or an installation of electrical plant of their own, generating their own electricity. If they were to get those power users to do away with their present means of obtaining power, they must be able to show them that they could give them a supply at a price at which it would pay them to scrap their existing plant and to take their power from a central company. They knew from the experience of those on the Tyneside that if they supplied current at a cheap rate they would get people to take a supply from the company on very advantageous terms. It was worthy of note that the two companies which were supplying electricity for power purposes at the lowest rate—the St. James' and Pall Mall, and the Westminster Electric Supply Companies—were companies whose area of supply lay in a district which was not an industrial one, but purely a residential area. Taking the first-named company, according to the last Board of Trade returns, they supplied 671,000 units at 1d. per unit for power, and 7,296,000 units at 3·47d. per unit for lighting. They would, therefore, see that the company were really able to make such a low charge for power because of the enormous number of units they generated for lighting. The supply for power was really a by-product of the company's work. If the figures of the purpose for which the units were sold were reversed, there would be a loss. Those remarks also applied to the Westminster Electric Supply Corporation. That company supplied 2,509,000 units for power at 1d. per unit, whilst no less than 11,262,000 units were sold for lighting purposes at a fraction more than 4d. They would, therefore, see that the income which the company received from the power supply formed a very small proportion of the actual output. As regarded the local authority which charged the lowest prices—the West Ham Corporation, who supplied current for power purposes at ·95d., a very large proportion of their supply was for traction purposes. That Corporation owned its own tramways and supplied them with current generated at its own works. The prices in the schedule proposed by the promoters were the lowest that had ever been brought before Parliament. As an instance, counsel said that if a manufacturer had a 25 per cent. load factor the maximum price worked out at ·57d. per unit. That, of course, was the maximum price which they could charge. A maximum charge had been fixed so as to meet the worst case, but it was quite possible that the charge would be lower—possibly it would be ½d. per unit. In the case of works which ran for 24 hours the charge would be considerably less. The Bill provided that unless the maximum demand exceeded 250 KW. the promoters should not supply electricity for power purposes without the consent of the authorised distributors, provided that the authorised distributors were prepared to supply such power user at a price which did not exceed that at which the promoters were willing to supply to such authorised distributors by more than 1 per cent. in respect of each 10 KW. or part of 10 KW. by which the maximum demand of such power user should fall short of 250 KW. By that clause the authorised distributor would get a fair profit. Under Clause 64 the promoters had power, if the profits amounted to a larger sum than was sufficient to pay the authorised rate of dividend—3 per cent.—to apply such surplus as follows: one-third to forming a sinking fund; one-third to reduction in the cost of electrical energy; and the remaining one-third towards increasing the dividend or such other purposes as the company might determine. In no other power Bills was there a purchase clause. As regarded London, however, there was a strong feeling that some provision as to purchase at the end of 42 years, or a longer period, should be inserted, and accordingly Clause 65 of the Bill provided for such a contingency. It left, of course, the question whether the purchase was to take place; that had to be decided by Parliament, and if they decided that the undertaking should be acquired by any body, the terms set out in the clause were substantially these: —If at the end of 42 years they had to sell the undertaking, the purchase price should be the payment of the amount properly expended on capital account as certified from time to time by the auditor, together with such sum (if any) as would be required to make up the aggregate amount of the dividends paid by the company up to the date of purchase to 6 per cent. upon the capital after deducting the value of the investments and moneys representing the sinking fund and the insurance and reserve funds. If it were purchased at the expiration of any 10 years after the end of 42 years, the purchase price should be the amount spent on capital account less the aforementioned funds. No allowance was to be made for goodwill or compulsory purchase, or for the prospective or future value of the undertaking. Those terms commended themselves to the promoters as reasonable and fair for the purchasing parties and the company. Dealing with the petitions against the Bill, Mr. Fitzgerald said that there were originally 17 opponents, but only 14 appeared there by Counsel to contest the Bill. The opposition, so far—if it was an opposition—from the existing companies and local authorities was almost under one head, and that was that they objected on the ground of competition. But where was the competition? They were not supplying any of the tramways and railways, with one exception. Where the local authority was supplying a tramway it was, he thought, almost invariably supplying a tramway which the authority owned. The large tramway companies had generating stations of their own, and so had the railways, and, therefore, so far as



the tramways and railways were concerned, it was practically not a serious competition to existing undertakings because they did not embark in that kind of business. With regard to small power users the promoters could only supply them directly if the authorised undertakers were not willing to supply them at the increased percentage above the rate at which they got the current from the bulk company. Against the objections had to be set the enormous advantage which electricity users would get from being able to obtain a supply at a cheap rate. As regarded the local authorities, their main objection was to the interference with the streets. Of course, where they had to lay down mains they must break up the roads, but the promoters had inserted in their Bill the provisions of the general Acts which amply protected the local authorities, and, in addition to that, they had inserted a clause giving the local authorities the right to appeal to the Board of Trade if they had any complaints. Then petitions had been presented by the other two companies—the London Electric (Joint Supply Bill) and the Kensington and Knightsbridge Supply Companies—which had similar Bills, but he did not think they could be regarded as affording any solution to the question which the Bill he was presenting was intended to solve. The Bill of the London, Westminster and Kensington Companies had for its main object the linking-up of five companies, so that it would be lawful for them to enter into an agreement with each other or all of them to provide electricity to one or all of them and for other purposes. That was a small proposal: they only asked to supply each other. He had no criticism to offer upon it, but no one could say that it afforded a solution to the question of giving a bulk supply for power purposes to the London area. The other proposal was contained in a Bill promoted by eight companies, which proposed to establish a Joint Committee. That Committee would be composed of a representative from each company and two representatives from the L.C.C.; he believed the L.C.C. did not wish to be represented. The Joint Committee asked for powers to purchase land, to take over and enlarge the existing stations of any of the companies, or, as he understood, any other company or local authority within the London area, and to entitle any authorised distributor, where a company or local authority objected to supplying him, to take a bulk supply from the Joint Committee. That was the substance of what the eight companies proposed to do—really what the five companies proposed to do, only on a larger scale. Counsel quoted from the speech of the chairman at the Charing Cross Electricity Co.'s meeting to show that it was not the intention of the Joint Committee "to raise £1,000,000 at once, a few thousands would do," he said; and he (Mr. Fitzgerald) contended that the proposal of the Joint Committee was not a solution of the difficulty. He had been informed that the North Metropolitan Power Companies had reserved their opposition, and, therefore, they did not appear. Continuing, counsel said that the capital proposed under the Bill to be authorised was £4,500,000 with one-third borrowing powers, a total of £6,000,000. The promoters believed that if the Bill passed substantially in its present form, there would be a reasonable probability of making a good investment, and the whole of the capital would be raised.

Friday, May 8th.

On May 8th Mr. H. F. Parshall, consulting engineer, called and examined by Mr. Talbot, said that he was one of the engineers called in by the L.C.C. to advise it in respect of the scheme for the supply of energy in bulk in London that was put forward by it last year. He had very carefully studied the conditions affecting the supply of electric current in London and the district.

Do you consider that the supply of electrical energy in London is an efficient and up-to-date supply?—No. It is very far from that.

Continuing, Witness said that at present London was supplied by 66 generating stations—36 were in the hands of the local authorities, and 30 in the hands of companies; 42 of these stations were in London, and 24 outside. The existing supply was given at 19 different pressures, and 14 different prices, and he did not think they could be usefully connected.

What would be necessary if these systems had to be interconnected?—Of course the proper way of doing it would be to put in a system of interconnecting mains between the different points, and a system of motor-generators if full use is to be taken of the steam plant; apart from the purely electrical conditions to be satisfied, material additions would have to be made to the generators, in order that the kind of electricity required at different points could be generated, and a new system of transformers and mains would be required in any case.

What do you say of the comparative cost of intercommunication with one another and the establishment of a separate bulk undertaking?—If the linking-up were made as comprehensive as our scheme, there would be no saving in capital—it would cost as much to do this as it would to put down a new bulk supply from a central station.

If a cheap supply is to be afforded this area, in your opinion it cannot be done by merely linking up the existing stations—it must be done by the establishment of a new supply, and by a central station?—That is so, for the reason that this linking-up does not provide for efficient steam units. Linking-up would at best be only a temporary measure.

By the Chairman: He knew where the existing stations were, the kind of plant and the capacity, and he thought it was very doubtful whether this linking-up would ever be done.

Further replying to Mr. Talbot, Witness said that considering the cost of generation under the two schemes, one of the advantages they claimed was that they would be able to generate more cheaply. He was satisfied that linking-up would not finally result in the cheapening of generation. There were 66 generating stations, and it was an obvious proposition, according to experience, that when electricity was generated at so many points the waste in labour and in coal was very considerable. Many of the existing stations were situated where they had no condensing water, and they were not particularly accessible to the railways, so that it was difficult for them to get coal. The central station they proposed to erect would be accessible for steam-borne coal. His scheme did not involve the scrapping of the existing stations; he did not see that anything radical need be done, so far as the existing stations were concerned. It would be to the interests of the existing distributors to take part of their supply from them.

Do you consider that the Bill promoted by the companies provides for a bulk supply scheme in the sense in which you have expressed the same idea?—No, I don't see how any bulk supply system can be provided by this scheme. The linking-up of the centres would take a good deal of the capital, and there is only a million pounds provided for it in the Bill. One million would not provide for any installation necessary for the supply of London. I have made very careful calculations, and find that five millions is nearer the figure.

It follows, therefore, that in your opinion the capital cost of intercommunication would be at least equal to the cost which you propose?—Yes.

The Chairman: Are you prepared to say what you think would be sufficient?—To provide what we consider a proper system for London, taking the demand in the Bill, we have provided 4½ millions, and in that we have taken the general area prescribed by Parliament. We have borrowing powers up to six millions.

Mr. Balfour Browne said it was only fair to say that the two areas were not the same.

Mr. Talbot: No, and that is why we say that ours is a better alternative scheme. There is no doubt that the fringe which we intend to supply represents a good deal.

Continuing, Mr. Parshall said that taking only the area which the companies proposed to supply, he did not consider that a million was sufficient. The bulk of his company's proposed capital expenditure of 4½ millions was inside the area of the present suppliers. He estimated that they would require at least 3½ millions to provide for the area which the present companies supplied.

Replying to the Chairman as to why there was such a large difference in the estimates, Witness said he could only conclude that the companies had not provided for as large a demand for power in the area as the promoters had. They had satisfied themselves that the demand was there, and they were fully prepared to supply it. Evidently the existing undertakers thought that the demand for power did not exist.

Further replying to Mr. Talbot, Witness said he thought they would be able to prove that even the 4½ millions which they proposed to spend on capital at the outset, would not be sufficient. When once electricity became cheap in the area, he believed it would become popular, and that the demand would come on at a reasonable rate. There was between 300,000 and 400,000 miscellaneous horse-power in London to-day that had not been provided for by electricity, and the reason why many people had not taken electric power was that it was so expensive that they could not afford it.

Mr. Balfour Browne: Is the 4½ millions necessary for the present demand?

Witness: Not for the present demand, but for the demand which will spring up provided the supply is available.

Replying to Lord Welby, Witness said he was aware that the estimate of the Administrative Co. last session was that five millions of capital would last five years. The present proposal of the London and District Co. was to spend 4½ millions, and they had borrowing powers up to 6 millions, which he estimated would take them through the first stage of the business.

By Mr. Talbot: He thought that in their own interests the existing distributors should support their scheme. They would undertake to supply them cheaper than they could supply themselves, which would enable them to develop their business more rapidly than by the present expensive methods. Most of the companies were handicapped by the purchase clause, so that they were having to pay rather heavily for their money, and they were not in a position to put down new plant. Further than that, most of them were too small, and their capital expenditure per unit must of necessity be great. When the Administrative Co. was promoting its Bill many of the largest and most important of the existing undertakers entered into provisional arrangements to take their supplies from them.

Mr. Balfour Browne said the agreement was that they would take their supplies from the Administrative Co. when their own load was exhausted.

Further examined by Mr. Talbot, Witness said that the existing suppliers had expended £3,900,000 on land and buildings. By their scheme they would only require £500,000 for the same purpose, which showed the waste of capital in having so many stations, and proved that centralisation was the right principle. If the promoters were right in their estimates of the demand that was likely to arise in the future, the increase of the existing stations in order to cope with it would involve a considerable nuisance on account of the situation of the stations. In their initial scheme they estimated for a 60,000-kw. station, and a 120,000-kw. station was about the limit of the scheme proposed at present. It would be obvious that in the 60,000-kw. stage they would have to take more land than was actually required, and spend more money on river works in view of extension, and it was estimated that the capital expenditure per kw. would amount to £45. In the case of their final stage when they had 120,000 kw., and had made

additional use of the land and the river works, the capital expenditure came out at £34 per KW.

You double your output and reduce your cost per KW. by £11?—Yes.

That estimate, continued witness, included the whole cost. The increase in the size of the installation would improve both the load and the diversity factor, because they were able to generate a greater number of units with a given plant capacity because the plant was used a greater number of hours in the year as the demand from the different classes of consumers came at different times. The total cost of generation by existing distributors for one year amounted to £1,388,477—£515,605 by local authorities, and £872,384 by companies.

How would that compare with your estimate of what a similar quantity of energy could be supplied to the London distributors for, by such a scheme as you propose?—We could do it with this bulk supply from our power house at a cost of £748,000.

That shows a difference of £640,000?—Yes. That would be saved to London in the cost of generation by our scheme. The existing companies would go on with the business of distributing precisely as now. Continuing, witness said that Chicago used to have a number of small stations, but by the adoption of a centralisation scheme the selling price of current to the individual customers had been reduced 40 per cent. in the course of the last 10 years. The Central Co. there was to-day supplying many companies which had their own power houses. Suggestions had been made that it would not be wise to rely upon one station for the supply of London, but there was nothing in that, because their station would be built in big sections independent of each other. Many of the large towns in the kingdom were being supplied from a central station. Their proposed area of supply was the same as that suggested by the L.C.C. last year, and comprised 451 square miles—117 within the county and 334 without. The actual quantity supplied in the area at the present time for lighting and power was 127,000 KW. They proposed to supply 157,000 KW. in the initial stage. It was anticipated that when the supply was available the local railway service in London would be electrified, and they estimated at the outset to supply 60,000 KW. for that purpose. They estimated that their supply to the present authorised distributors in the initial stage would amount to 51,000 KW., and to miscellaneous power users 15,000 KW. The proposed site at Barking was an excellent one for the purpose. It afforded exceptional facilities for obtaining sea-borne coal. They proposed to generate three-phase alternating current, and authorised distributors, railway companies and very large users could transform it as they required. They proposed to transmit at a pressure of 15,000 volts, as that would give them the best results from the capital employed. They would have 14 control stations. The present distributors would save £224,000 per year in the cost of generation if they took current from them, and that should mean that their business would considerably increase owing to the diminution in price.

On Monday and Tuesday Mr. Parshall was again in the witness-box.

(*To be continued.*)

New London Building Regulations: Electrical Engineers' Requirements.

At the House of Commons on May 6th, the Police and Sanitary Committee, presided over by Mr. Layland Barratt, accepted important provisions contained in the L.C.C. (General Powers) Bill, which are of great importance to electrical manufacturers. The effect of these was to repeal three sections of the London Building Act, 1894, dealing with the cubical capacity of buildings, consent to larger dimensions, and fixing rules as to the uniting of buildings, and to substitute new provisions, removing certain restrictions, and giving the County Council discretionary power to extend, under special circumstances, the existing limit of the cubical capacity of buildings allowed and the size of openings between buildings. Under the London Building Act, it was explained, there was a limit to the capacity of a building of the warehouse class of 250,000 cb. ft., the Council having the discretion, on the report of the Superintending Architect and the Chief Officer of the Fire Brigade, to extend the capacity to 450,000 cb. ft., but they were unable to allow any further extension. The L.C.C. had received representations from trade representatives, and especially from the society representing the engineering trade in London (the London and District Association of Engineering Employers) that for the trade requirements of to-day this limit of 450,000 cb. ft. was very injurious in certain conditions; there were certain conditions where a larger cubic capacity was essential. No such stringent limit obtained in any of the large manufacturing towns in the provinces, and in the case of Liverpool, which had a limit, it was possible and usual to relax this in suitable cases. Another alteration was to the rule that where a large building was divided into divisions, the division must be by party walls, the Committee being informed that in practice it was sometimes found that it would be much more convenient to have these divisions made separate by horizontal floors of fire-resisting materials, which would be just as serviceable for preventing the spreading of fire as party walls. The council asked for discretionary powers to allow these horizontal floors in suitable circumstances, and also to sanction openings in buildings of larger dimensions than those allowed by the London Building Act, 1894, when larger openings were shown to be necessary for the purpose of trade requirements, and where the construction was such as to be efficient in regard to the prevention of the spreading of fire.

One of the principal witnesses in support of the clauses proposed by the promoters was Mr. Alexander Siemens, of Siemens Bros. and Co., Ltd., and Siemens Bros. Dynamo Works, Ltd., which firms have extensive electrical manufacturing works at Woolwich and Stafford. Speaking not merely on account of his own companies, but also on behalf of the London and District Association of Engineering Employers, he heartily supported the view that in the interests of trade it was highly desirable that the proposals should be passed. The present restrictions undoubtedly interfered with industry in London. Giving an instance, he informed the Committee that owing to the increased size of engines and machines which now had to be made, they had found it quite impossible to carry out certain work at the dynamo works at Woolwich. There, in the case of large machinery, it had to be erected in several shops on account of the stringent limit as to dimensions. The restrictions as to the size of doors between adjoining shops was a matter which seriously interfered with business; they were obliged to take machines to pieces and re-erect them in adjoining shops because they could not make them in the one shop. As a result of the inconvenient regulations in the Metropolis, witness's firm had had to take work into the provinces for execution, and he mentioned their erection at Stafford of a large new machine shop of something like 2,000,000 cb. ft. capacity. The size of machines was very much larger than in 1894, and large shops were absolutely necessary for making the machines required to-day. Owing to the restrictions, various firms had left London, and various provincial towns were circularising London employers, suggesting the advisability of their transferring their works. He expressed the opinion that the risks of fire were less in a large shop, where a foreman could see what was going on, and where it was easier to take precautions than when a building was divided up into small rooms.

Electric Lighting Provisional Order (No. 1) Confirmation Bill.—On Monday the first electric lighting Confirmation Bill came before the Examiner for proof of Standing Orders, and was referred to second reading. The Bill confirms the following Board of Trade orders:—(1) To the Urban District of Bispham-with-Norbreck, in the County of Lancashire; (2) To the Caldy Manor Estate Co., Ltd., in respect of part of the parish of Caldy, in the Rural District of Wirral, in the County of Cheshire; (3) To Messrs. J. B. Saunders & Co., in respect to the Borough of Carmarthen. Powers are not to be exercised unless the undertaking is transferred to a registered company; (4) To the Fleetwood U.D.C., in the County of Lancashire. Power is given to the Council to purchase the undertaking of the Fleetwood and District Electric Light and Power Syndicate, Ltd.; (5) To Geo. Balfour, of 9, Cloak Lane, Cannon Street, London, E.C., electrical engineer, in respect of the rural district of Halesowen, in the County of Worcester; (6) To the Rural District Council of Wirral in respect of the township of Heswall-w-Oldfield, in the County of Chester; (7) To the Lowestoft Corporation for the amendment of the Lowestoft Electric Lighting Order, 1898; (8) To the Lymington Electric Light and Power Co., Ltd., in respect of the parishes of Boldre and Sway, and parts of the parishes of Milford and Hordle, all in the rural district of Lymington, and for the amendment of the Lymington Electric Lighting Order, 1899; (9) To the Portsmouth Corporation, for the amendment of the Portsmouth Electric Lighting Order, 1890; (10) To the Corporation of Southampton, for the amendment of the Southampton Electric Lighting Orders of 1895 and 1897; (11) To the Woking Electric Supply Co., in respect of the extension and their area of supply to the parish of Laleham, and portions of the parish of Littleton, the parishes of Thorpe, Cobham, Wisley, Ockham, Ripley, and Pirbright.

Contractors and Rates of Wages.—In Friday's Parliamentary Papers Mr. Tyson Wilson asks the Postmaster-General whether he is aware that the firm of Siemens Bros., who supply telephone cabinets and other articles to his department, only pay 10d. per hour to the joiners employed on this work, the standard rate of wage being 10½d. per hour; whether he is aware that the firm absolutely refuses to meet the representatives of the Joiners' Society, although they have made several requests to the firm for an interview; and whether he will take steps to induce the firm to pay the standard rate of wage and comply with the rules agreed upon between employers and employés engaged in similar work. Mr. Buxton, in reply, says that from inquiries he has made he has found that Messrs. Siemens employ at their Woolwich factory (where Post Office work is occasionally done) about 40 men on work consisting partly of joinery and partly of cabinet making, at the rate of 10d. an hour for a week of 54 hours. When employed on piece-work their earnings are increased by about 20 per cent. These men enjoy special privileges, including free medical attendance and a prospective pension.

Highgate Hill Tramway Bill.—The Lord Chairman of Committees has reported that the promoters of the Highgate Hill Tramways Bill have notified their intention of not proceeding with the measure. Under the Bill it was sought to electrify the line and to postpone the purchase of the undertaking by the London County Council and the Hornsey Corporation.

Scotch Electric Lighting Orders.—On Monday the Examiner found that Standing Orders have been complied with in the case of the Electric Lighting Provisional Orders Confirmation (No. 2) Bill. The Bill confirms Board of Trade Orders in regard to the following localities: *Barrhead.*—Order granted to the Strathclyde Electricity Supply Co., Ltd., in respect of the Burgh of Barrhead, in the County of Renfrew. *Clydebank.*—Order to the Clyde Valley Electrical Power Co. amending the Clydebank Electric Lighting Order, 1901. *Dundee.*—Order to the Dundee Gas Commissioners in regard to the extension of the City and Royal Burgh of Dundee.

Rutherglen.—Order to the Provost and Councillors of the Royal Burgh of Rutherglen.

The Potteries Federation.—The Local Government Provisional Order (No. 3) Bill, which came before the Examiner on Monday, deals with the proposed federation of the Boroughs of Burslem, Hanley, Longton, Stoke-on-Trent and the Urban Districts of Fenton and Tunstall. By Article 16 provision is made for vesting in the new Corporation the various electric lighting undertakings, which are as follows: The Burslem Electric Lighting Order, 1898; Burslem Extension Order, 1899; Burslem Order, extension to Tunstall, 1905; Hanley Order, 1891; Longton Order, 1899; Stoke-on-Trent Order, 1898; Stoke-on-Trent Extension Order, 1907; Fenton Order, 1907. Clauses are put in for the protection of the Potteries Electric Traction, Ltd. The Standing Orders were found to have been complied with, and the Bill was ordered to be reported to the House.

BUSINESS NOTES.

The New Danish Tariff.—A new tariff has just been sanctioned by the Danish Parliament, and will come into operation on January 1st, 1909. Among the alterations may be mentioned those relating to dynamos and motors, which will be subject to a duty of 7·5 per cent. *ad valorem*, and other machinery will be liable to 5 per cent. of the value. These rates compare with the present duty of 6¼ ores per kilogramme, or approximately 3s. 5d. per cwt.

Electric Clocks.—At the sitting of the Metropolitan Asylums Board on Saturday, the General Purposes Committee reported having had before them an offer from the Magneta Co. to extend their system of electric clocks in the office building by the provision of 30 additional dials, at a cost of £19 per annum. At present there are eight dials and one master clock of this company installed at a rental of £7 per annum. It was agreed to accept the offer.

Trade Announcements.—The British Electric Calibrated Fuse Co., Ltd., have extended their factory and plant owing to increase of business since obtaining the manufacturing rights of the Koolark fuse. They have transferred their head office to the works at Harpenden, and all communications should be addressed there.

Mr. W. E. Shuttleworth, late chief electrical engineer to Earles' Shipbuilding Co., Ltd., has commenced business as the Humber Electrical Engineering Co. (electrical engineers and contractors), at 1, Baker Street, Hull. Manufacturers' and agents' catalogues, &c., are invited.

Mr. C. Ingleby has taken over the Jones-Westwood Electrical Manufacturing Co., of Elland Road, Leeds, and will continue it as heretofore, but under the name of Ingleby & Co. Mr. Ingleby has had c.c. and a.c. design and constructional experience with the Bergmann Co. and the B.T.-H. Co., Ltd.

Messrs. Major & Co., Ltd., have closed their branch establishment at Elland Road, Leeds, and all correspondence should be sent to the head office, Sculcoates, Hull.

Messrs. Alex. Smith & Son (agents for W. T. Henley's Telegraph Works Co., Ltd.) have removed from Hanover Street to 9, Howard Street, Glasgow.

The *Engineering Times*, which started as a monthly and then became a weekly, now notifies us that it is once more becoming a monthly at the price of 2d.

Messrs. Bray, Markham & Reiss, Ltd., Walthamstow, have appointed the British General Electrical Co., of 17, Hatton Garden, London, E.C., as their sole agents for London and district.

Mr. Percy E. A. Warren notifies that he has severed his connection with Messrs. Warren, Beattie & Co., Ltd., and in conjunction with Mr. G. P. Howkins has commenced business as electric light and power engineers (Warren, Howkins & Co.) at Milburn House, Newcastle-on-Tyne.

Book Notices.—"The Week-End and Holiday A B C." May. London: 119, Pall Mall, S.W. 1908. Price 6d. net.

"Farm Buildings, &c." By T. Winder. With a chapter on the Application of Electricity to Farming and Agriculture, by J. W. Beauchamp. Sheffield: Pawson & Brailsford. 1908. Price 6s. 6d. net.

"Motoring Annual and Motorists' Year Book, 1908." London: Motoring Illustrated. 1908. Price 2s. 6d. net.

"National Physical Laboratory Collected Researches." Vols. 3 and 4. Report for the year 1907. Teddington: National Physical Laboratory. 1908.

Surface Condensing Plants.—We understand that the surface condensing plant department of Messrs. Willans and Robinson, Ltd., has during the past month or two received a good many orders for surface condensers of either the "Contraflo" or "Vacuum Augmenter" types, among them being the following:—Two condensers for dealing with 4,000 kw. each for Glasgow Corporation; one for dealing with 12,000 lb. of steam per hour for a mine near Johannesburg; one for 30,000 lb. of steam per hour for Durban Corporation; one for 2,000 lb. of steam for Sydney (N.S.W.) University; one for dealing with a 1,500-kw. turbine for Islington Corporation; one for a 1,000-kw. turbine for Southampton Corporation; one for a 300-kw. exhaust steam turbine for Messrs. Crompton & Co.; and one for dealing with a 250-kw. reciprocating engine for Stoke Corporation.

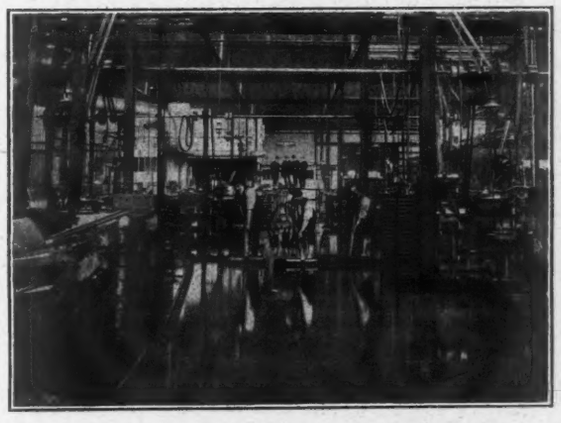
Dissolutions and Liquidations.—South-Western Electrical Co., Ltd.—A meeting is to be held at 1, Oxford Court, Cannon Street, E.C., to hear an account of the winding up from the liquidator, Mr. F. S. Salaman.

Pioneer Gas, Electric Light and Power Co. of South Africa, Ltd.—A meeting is to be held at 35, New Broad Street, E.C., on June 12th, to hear an account of the winding up from the liquidator, Mr. R. W. Blackburn.

"Uneo" Asbestos Lubricating Co., Ltd.—This company (Mr. J. B. Atherton, chairman) is winding up voluntarily, with Mr. D. Hogg, 9, Parr Street, Liverpool, as liquidator, who is authorised to carry through an agreement with the Empire Lubricating Co.

Fors Accumulator, 110, Strand, and 15, Dyott Street, New Oxford Street.—Messrs. H. F. Joel and R. Pape, accumulator manufacturers, have dissolved partnership. Mr. Pape attends to debts.

Works Flooded.—To be flooded with good work is better than to have a good works flooded. The former may have its difficulties, but it has its compensations; the latter—well, an illustration of it may be seen in the accompanying photograph, where Adams' heroic sons are endeavouring to keep back the waters, and to better effect than did old Canute of unwise-



A Bedford Rheostat Factory under Water.

counsellor fame. The view is that of the rheostat factory of the Adams Manufacturing Co., Ltd., at Bedford, where flooding of this kind, at any rate, is not an every-day experience. The employés of the company will have good reason to remember the floods of 1908, when boats and punts had to be requisitioned for the conveyance of stores, raw material, and finished parts, out of reach of further damage. In sending us this photograph the company say nothing whatever about the weather!

For Sale.—Certain heating and generating plant at the Nottingham Post Office is being offered for sale. Some particulars appear among our advertisements to-day.

Messrs. Wm. Coates & Son, Ltd., of Dublin, are offering for sale electric lighting plant which is briefly particularised in our advertisement pages to-day.

Urbanora House.—With reference to the Note on the electrical equipment of Urbanora House in our last issue, we are informed that that part of the material was supplied by Messrs. Krupka & Jacoby, of 61 and 62, Watling Street, E.C., who were the original contractors for the material. The electric sign mentioned in the Note is their patent "Luxol" sign, and the tubular lamps are also their patent, while they supplied motors, &c., through Mr. Johnson.

Bankruptcy Proceedings.—Ernest Noel Owen, electrical engineer, 1, Grove Cottages, Hampstead, N.W.—The first meeting of the creditors under this failure was held on Monday at the London Bankruptcy Court. The case was left with the Official Receiver to be wound up in the ordinary course of bankruptcy.

Catalogues and Lists.—The Premier Electric Heating Co., Ashley Street, Birmingham.—Specimen copies of pamphlets which they are furnishing to supply companies, contractors and others, for distribution among consumers. Electric kettles and heating irons are shown, as are also luminous and convector heaters. The lists are supplied either with or without the firm's name.

The Union Electric Co., Ltd., Southwark, S.E.—Advance copy of list No. 8,005, containing table of particulars and prices of their electrostatic voltmeters having a range up to 120,000 volts.

Maschinenfabrik Oerlikon, London, W.C.—Publication No. 42 (14 pp.), giving a description of an equalising system installed by them for some rolling mills at Sandviken, Sweden.

MESSRS. W. F. JONES, ROSOMAN & CO., 5, Castle Street, Finsbury, E.C.—A number of price sheets of switches, cut-outs and ironclad switchgear. Some motor panels specially designed for colliery, factory and shipyard service, where totally enclosed apparatus is required, are shown.

MESSRS. KRAMOS, LTD., BATH.—Show sheet giving illustrations of their various electric hoists, winches, lifts, &c.

MESSRS. ALFRED HERBERT, LTD., Coventry.—Catalogue of 80 odd pages, setting out in their usual manner descriptive particulars and excellent half-tone illustrations of their latest capstan lathes.

THE POWER PLANT CO., LTD., Temple Bar House, E.C.—Circular describing their machine-cut double helical wheels.

PEARSON FIRE ALARM, LTD., Jewin House, Redcross Street, E.C. —Catalogue containing a description of their automatic fire alarm system. Contracts have recently been closed to fit up the premises of Messrs. Rylands & Sons, Ltd., Bradbury, Greatorex & Co., Ltd., and the *Daily Mail*.

THE GENERAL ELECTRIC CO., LTD., 71, Queen Victoria Street, E.C.—Booklet (No. K 1,234) in which are illustrated particulars and prices of their "Phone-Eze" telephone bracket for desk service, which has been already described in these pages.

MESSRS. BALCKE & CO., 27, Clements Lane, E.C.—Catalogue of 48 pages, giving a large number of photographic views, also line diagrams, of water and air cooling towers erected on their system, the majority of those shown being situated at electricity supply or traction generating stations in London and the provinces. The various sections of the catalogue cover respectively chimney coolers, open type coolers, fan coolers, and air cooling plants. One of the illustrations shows a brick chimney cooling tower at the Central London Railway power station at Shepherd's Bush, which is the first of its kind in this country, although the firm have supplied a great many of even considerably larger size on the Continent—for instance, the installation at the Corporation electricity works, Essen, consisting of one brick chimney tower, two steel towers with wooden lining and interiors, and one wooden cooling tower, for a total capacity of 1,700,000 gallons of water per hour, which is claimed to be the largest installation of its kind in the whole world.

ARMORDUCT MANUFACTURING CO., LTD., Farringdon Avenue, London, E.C.—New catalogue (No. L.H/910) in which are given 24 pages of matter and blocks concerning the "Little-Hustler" electrically-operated drills and grinders. Prices, &c., appear in tabular form.

THE HUDSON ECONOMISER CO. (1907), LTD., 2, Bishopsgate Street Without, London, E.C.—12-page illustrated catalogue describing the Hudson economiser system of water cooling, which in its then form was exhibited at the Engineering Exhibition at Olympia a year or two ago. A number of open type coolers at breweries, wire works, &c., and a chimney type tower at a works in the North are shown.

IDEAL PLANTS, LTD., Macdonald's Lane, Corporation Street, Manchester.—This company, which recently acquired the business of R. J. Nicholson & Co., sends us several new lists descriptive of small petrol-driven self-contained electric lighting plants, of which we have already published particulars.

LONDON ELECTRIC TRANSFORMER CO., 10, City Road, E.C.— Leaflet showing their "Adapter transformers," for use with metallic-filament lamps of 25 volts; the transformer fits an ordinary lamp socket, and carries the lamp, while by twisting the lamp socket variable voltage and candle-power are obtained. Particulars are sent also of other transformers for use with these lamps.

MESSRS. J. H. HEATHMAN & CO., Parson's Green, S.W.— Particulars of their new "Itiliti" steps, which fold up to a thickness of only 2¾ in.

WG. SYSTEMS, LTD., Craven House, Kingsway, W.C.—Specimens of their squared paper charts, which are made up in pads of 50, printed for months, years and days, as "WG. Business Barometers," or unprinted as "WG. Graphic Charts." Also particulars of files and diaries.

MESSRS. CUTLER, WARDLE & CO., LTD., 35-7, Dickinson Street, Manchester.—Leaflet illustrating their "Streetlite" lantern, which is specially designed for metallic-filament lamps to take the place of arc lamps for lighting streets, shops, &c. The lantern is of simple construction, weatherproof, and provided with reflectors, and is made in various finishes.

LIGHTING and POWER NOTES.

Aberdare.—The U.D.C. has decided to engage Mr. Sellon, at a fee of 25 guineas, to prepare a preliminary report on the E.L. question.

Bath.—The Electric Lighting Committee recommends that an agreement should be entered into with Mr. Ernest Schenk for the purchase of the electrical undertaking, and that application should be made to the B. of T. for its sanction to the transfer. Mr. Schenk is prepared to make an immediate cash deposit of £22,500 as part payment, and further to spend at least £30,000 during the next 18 months in extensions, £20,000 of which will be spent in the city.

Belfast.—At the weekly meeting of the Tramways and Electrical Committee on the 11th inst. Mr. Bloxam, the electrical engineer, presented his report for the year ending March 31st last, from which it appeared that the total output was 10,883,658 units, or an increase of 12·7 per cent., and the total revenue £57,004, or an increase of 11·6 per cent.; owing to the cost of coals the cost of production had risen from ·634d. per unit to ·753d. per unit. The net profit on the year's working was £8,198 16s. He recommended the allocation of sums amounting to about £6,000 for various purposes. The report was adopted. From the financial statement, afterwards submitted, it appeared that the tramway traffic revenue amounted to £193,813, and the expenditure to £119,823, leaving a gross profit of £73,990.

Bexhill.—At its meeting on Monday (May 11th) the T.C. expressed great pleasure with the working of the electricity undertaking during the year ending March, 1908, which showed a net profit of £1,018, after payment of interest and loan charges. Revenue amounted to £9,700, and working expenses to £5,249. The net profit has been allocated as follows: £131, depreciation of capital assets; £696, debit balance on revenue account, March, 1907, leaving a credit balance of £190.

Bolton.—At a recent meeting of the Electricity Committee it was decided to allocate £7,500 in aid of the rates, as against £6,000 last year; it was also estimated that the sum of £6,000 would next year be available for the same purpose.

Cheshire.—After having been closed in order that it might be converted from hydraulic to electrical working, at a cost of £25,000, the famous Anderton lift on the River Weaver, in Cheshire, is again open to traffic. It transfers boats bodily from the Weaver to the Staffordshire Canal, and *vice versa*, and was the first hydraulic lift in Britain. The new electrical scheme, invented by Mr. Saner, the River Weaver engineer, is working very satisfactorily.

Continental Notes.—ITALY.—Application has been made to the authorities of the province of Novara for a concession to put down a plant to utilise the water-power of the River Cannobino at Cannobino in the generation of electrical energy for lighting and power purposes.

Dartford. — The B. of T. having asked the R.D.C. whether it approves of the E.L. order for the parishes of Stone and Swanscombe, granted to the Kent Electric Power Syndicate being revoked, the Council has replied that it is in favour of the revocation of the order.

Dudley. — The output of the electricity department during the past twelve months was 2,203,097 units, as compared with 1,991,904 in 1906-7. The tramways took 1,050,910 (an increase of 84,666), private customers 422,333 (an increase of 30,471), and motors 413,727 units (an increase of 94,000). The income amounted to £12,792; the gross profit to £5,985; and the net profit to £344, as compared with £68 last year.

Dunfermline.—At the Council meeting on Monday an animated discussion took place over the electric lighting proposals. A request was made for further information than was included in the Committee's minute, which stated that two alternative schemes were contained in a letter from Sir Alex. Kennedy, but that the Committee considered one of these inexpedient, and agreed to instruct the expert to continue his negotiations on the basis of the other scheme.

East Africa.—A proposal is on foot to establish an electric lighting undertaking in Mombasa, a Mr. Anderson being prepared to take over a concession.

Eastry.—The R.D.C. has decided to inform the B. of T. that it favours the revocation of the E.L. order granted in 1903 to the Kent Electric Power Syndicate.

Elland.—The U.D.C. has applied to the L.G.B. for a loan of £3,000 for electricity purposes in connection with the proposed tramway supply.

Hanley.—The North Staffordshire Railway Co. has just completed a scheme of lighting the whole of the passenger station, goods yard, warehouses and offices with electricity. A generating plant consisting of two 30-H.P. gas engines and dynamos, and a battery of accumulators is installed. This plant provides power for four 20-H.P. electric capstans, also for three electric cranes in the warehouse.

Heckmondwike.—The U.D.C. has resolved to open an office and showroom in High Street in connection with the E.L. undertaking.

London.—CITY.—The annual report of the superintendent of the London City Central Markets, which has just been issued, states that the new "Oriflame" arc lamps have greatly improved the lighting of the fruit and vegetable section of the markets, and that the introduction of similar lighting in the other sections would prove advantageous. The illumination from the arc lamps around the market, installed during the past year, is giving general satisfaction.

SOUTHWARK.—The Electricity Committee being doubtful whether the free-wiring policy has been a success, a carefully-devised schedule, calculated to elicit detailed information as to the expense incurred upon, and the return from, each free-wired customer, has been approved, and a complete return is expected shortly.

Manchester.—The Electricity Committee has adopted the estimates of income and expenditure for the current year. The surplus for the year just ended, after meeting interest and sinking fund charges and providing £40,000 for prospective renewals of plant (instead of £30,000 as estimated in April, 1907),

was £18,177. Of this surplus £10,000 went, as arranged, in aid of rates and the balance to the reserve fund. The results would have been even better, to the extent of about £9,000, but for the high price of coal. To the Tramways Committee energy has been supplied at 1·15d., instead of at 1·28d. per unit as in 1906-7, representing a saving of £13,520. A further reduction in the traction price is probable in the year now commenced. The estimates for the ensuing year enable the Committee to promise another grant of £10,000 in aid of rates.

Milton Regis (Kent).—The U.D.C. has decided to inform the B. of T. that it is of opinion that the Sittingbourne and Milton E.L. Order, which was granted to a syndicate, should be revoked.

Newcastle-under-Lyne.—The T.C. has applied to the L.G.B. for a loan of £700 for cables, &c.

South Africa.—Victoria Falls.—A German newspaper has published, on what is stated to be the authority of the chief engineer of the Victoria Falls Power Co., some particulars respecting the position of the works of this undertaking. As is known, the company possesses two power stations, one of which is situated at Brakpan (the former Rand Central Electric Works), and the other at Germiston (the station of the former General Electric Power Co.). At the present time a central plant is being built at Brakpan to yield 6,000 kw., divided into two units of 3,000 kw. each, and is to be ready for working next August or September. The old plant at Brakpan is of 3,000-kw. capacity, and is only to serve as reserve for the new generating sets in the future. It is proposed to establish new long-distance aerial conductors between Brakpan and Germiston for a pressure of 40,000 volts, whereas the old transmission was arranged for a line pressure of 10,000 volts. The new transmission line will be in duplicate, so that in the event of one line developing a fault, it will only be necessary to switch on to the other in order to maintain supply to consumers. It is intended to demolish the Germiston station, which is antiquated, and to erect in its place a plant of 12,000 kw. The preparatory works have already been commenced, although the station will not be ready until the beginning of 1909. The chief technical management is in the hands of Mr. H. Spengel, who was formerly manager of the Rand Central Electric Works.

Stockport.—A L.G.B. inquiry was held on May 7th into the application of the T.C. for a loan of £10,500 for electricity purposes. Of this, £3,100 was for a generating set, £600 for a water softening plant, £1,500 for a water-tube boiler, £250 for an electrical feed pump, £100 for a 125-h.p. motor, £2,500 for mains extensions, and £2,500 for the erection of new offices, &c. The application was unopposed.

Swansea.—The Electricity Committee has had under consideration an offer by Mr. R. Borlase Matthews to develop electricity supply in the town—the Corporation to pay a percentage on the results.

Sutton Coldfield.—The annual report of the electrical engineer shows that the gross profit is sufficient to cover capital charges and the deficit of 1907, leaving a small amount to be carried forward. The gross profit was £2,691, or 6·61 per cent. on the average capital outlay.

Taunton.—A L.G.B. inquiry was recently held with reference to an application made by the T.C. for sanction to raise a loan of £2,000 for the purposes of electric lighting, this amount being made up of the following sums:—Mains, £530; meters, £330; house services, £550; transformers, £300; pump, £50; and excess of expenditure on previous loan, £240. The town clerk said it was thought the present proposed loan would carry the electric light concern over the next three years. The inspector remarked that the T.C. had no power to borrow money for the purchase of arc lamps to be hired by shopkeepers.

Tonbridge.—In consequence of complaints made by local electrical contractors of private work being undertaken, in their spare time, by Council employés, the U.D.C. has decided that no outside work shall be undertaken by any of the employés of the Council, unless they obtain the Council's previous permission.

West Bromwich.—The T.C. has agreed to supply Messrs. Akrill, Ltd., with 140,000 units per annum, they guaranteeing to take a minimum of 80,000 units per annum for seven years. Messrs. Brockhouse, Ltd., have also agreed to a guaranteed consumption of 50,000 units per annum for five years, and the Corporation is to extend the mains to both works.

West Ham.—The L.G.B. has sanctioned the borrowing of amounts totalling £64,317, in respect of the electricity undertaking, including the following items:—Additional plant, £17,076; extensions to Silvertown district, £17,212; prospective expenditure on mains, £14,300; prospective expenditure on transformers, £6,000; prospective expenditure on meters, £3,000; excess expenditure, Abbey Mills station, £1,442; excess expenditure, Canning Town station, £5,287.

TRAMWAY and RAILWAY NOTES.

Aston.—As a result of recent conferences, the Handsworth authorities have entered into an agreement to purchase and electrify the Villa Road tramway, and arrangements have been made for through running from Perry Barr to Birmingham.

Accrington.—Referring to the decision of the T.C. to purchase two single-deck cars from the Brush Electrical Engineering Co., at a cost of £695 each, at the annual meeting last week, Mr. Crawford moved that the Electricity Committee be instructed to send a deputation to inquire as to the rates of remuneration, and the conditions of labour under which the cars would be built. This was defeated.

Blackburn.—On May 8th an inquiry was held by the Light Railway Commissioners as to the expediency of granting an application by the Blackburn, Whalley and Padiham Light Railway Co., for a revival and extension of time for the proposed construction of a light railway in those districts. The Commissioners granted the application, but having heard all the objections of the Blackburn Corporation, the Lancashire County Council and the Padiham District Council, they decided to insert clauses in the order for their protection before submitting it to the Board of Trade. They could not insist on a width of 27 ft. as a minimum for all roads, as asked for.

Bournemouth.—At the B. of T. inquiry, opened by Major Pringle, in regard to the recent tramway accident, it was elicited that only three of the four magnetic brake shoes were in use on the car, but this number or, indeed, the hand-brake only, was stated to be sufficient for the control of the car on the route in question.

Burnley.—The result of the past year's working of the Corporation tramways is the adding to the reserve and depreciation fund of £11,369; this fund now stands at £32,608. The traffic revenue amounted to £64,261, as compared with £62,699 for the previous year; and the working expenses were £39,701, in comparison with £40,781 the previous year. The passengers carried numbered 12,355,958, an increase of 388,460 on the previous year.

Cardiff.—Mr. Arthur Ellis reported to his Committee this week that the profits for the year ending March, 1908, were £4,400. During the year the receipts had increased by £3,428, and running expenses had decreased by £3,684, while advertisements had brought in £1,500—a total improvement of £8,612; but there had been an increase of £1,835 in loan charges and £3,764 in track repairs, also a £2,000 increase in the cost of coal, a total of £7,599.

Continental Notes.—France.—Good progress is being made with the conversion of the horse tramways in Calais to electric traction. The power station has already been completed and the first cars have been delivered.

Dudley.—At the T.C. meeting last week Alderman John Hughes complained of the extraordinary delay that had occurred in reference to the purchase and leasing of the local tramways. The Corporation had incurred very heavy costs in connection with the various arbitrations and lawsuits, and unless the company were ready to complete the agreement, he was prepared to propose at the next meeting that an action be taken against the company for the recovery of the expenses that had been incurred.

Dumbarton.—Colonel Yorke, on behalf of the B. of T., visited Dumbarton on Thursday, and inspected the section of the new county tramway scheme which has been constructed between Dumbarton and Alexandria; the line was forthwith thrown open to traffic. A three minutes' service is being given. This is the opening of the first section of the tramway line which will link Glasgow with Loch Lomond. At present the contractors are engaged on the extension from Alexandria to Jamestown and Balloch (Loch Lomond), while on the other side the work of connecting the town with the junction of the Glasgow system at Dalmuir is rapidly proceeding. It is expected that the whole line will be open for traffic in June.

Dysart (Fifeshire).—It is under contemplation by the Wemyss District Tramway Co. to extend its present system so as to secure the Dysart traffic, by laying down a branch line from North Lodge to the White Gates, Dysart, and continuing it to Kirkcaldy Hospital, where the line will join the Kirkcaldy system.

East Ham.—The B. of T. has sanctioned the borrowing of £8,000 for the purchase of the North Metropolitan Tramway track in Romford Road. Application has been made for sanction to the following loans:—£1,000 for roof coverings to tramcars; £1,620 for cooling plant for the electricity station; and £2,000 for extensions of mains.

Erdington.—The report of the Tramways and Electric Light Committee shows that the working of the tramways from April 2nd, 1907, to March 31st, 1908, resulted in a profit of £1,960. The receipts amounted to £6,254, and the payments absorbed £4,294. The Committee recommended that the sum of £600 be placed to reserve, and that the balance, £1,360, be paid in aid of the rates.

Glasgow.—A question has arisen between the Corporation Tramway Department and the Dumbartonshire Tramway Co., the latter having expressed a desire to make a connection with the former system at a bridge. The Clydebank T.C., within whose jurisdiction the bridge lies, recommends that no such connection be made till the bridge is widened.

A report dealing with the suggested extensions both inside and outside the city boundaries and with the general policy of the manager, Mr. J. Dalrymple, on the whole question has been issued to the members of the T.C. The sub-committee recommends the

construction of certain lines as soon as possible, and that the Corporation approve of the principle that Parliamentary powers for extensions outside the city be applied for only at the request, and with the general concurrence, of the local authorities of the districts interested in the making of such extensions. The sub-committee is of opinion that the proposed extensions will meet the immediate requirements within the city area and in the suburbs. In addition, the sub-committee recommended that construction of certain extensions be delayed pending further developments. In concluding his report, Mr. Dalrymple points out that the cost of all the new lines, extending to 35 miles, would amount to about £557,225. This estimate did not include the cost of the two new bridges over the river, although he had no doubt that the Tramways Committee might consider it was equitable that part of the cost of such bridges should be borne by the Tramways Department. The T.C. discuss the matter on the 14th inst.

Halifax.—The report of Major Cardew, R.E., and Mr. H. Graham Harris on the working and management of the Corporation tramways has just been issued. It is pointed out that extreme conditions as to grades, curves and roads are met with on the system, and that safety can only be secured by unremitting attention to the maintenance and efficiency of the cars and track. The adoption of longer wheel-base cars of the single-deck type is urged, also that top-covered cars should not be used on steep grades. Among the final recommendations is the following relating to upkeep:—

"We would most strongly impress upon the Committee the necessity for more careful attention to the upkeep and cleaning of the motors and all accessories than appears to have been exercised in the past. Numerous motors under repair were shown us, in which there was evidence of damage caused by the motor having been allowed to run too long without attention. These remarks also apply to the rheostats, cut-offs, wiring, and electrical and mechanical equipment generally."

Japan.—According to the Japanese Press, a company styled the "Kiushiu Electric Railway Joint Stock Co.," with a capital of about £206,500, has been formed for the purpose of constructing an electric railway, 26 kilometres in length, from Moji through Kokura and Yawata to Kurosaki, as well as a branch, 9 kilometres long, from Kokura through Tobata to Yawata.

Leeds.—The Corporation has decided to extend the Headingley tramway route to Lawnswood as a single track.

London.—The Metropolitan Railway Co. has at last decided to equip its routes with automatic signals, a contract having been placed with the McKenzie-Holland and Westinghouse Power Signal Co., for the entire equipment of the Aldgate-Bishop's Road and Praed Street sections with the Johnson all-electric system, which gives similar working features to those found on the District Railway. It is expected that the contract will take some eight months to complete, owing to the limited hours of working.

The Metropolitan District Railway Co. has inaugurated a non-stop service of trains between the Mansion House and Wimbledon.

The Metropolitan Association of Electric Tramway Managers is suggesting to various Metropolitan Councils that representations should be made to Parliament with a view to securing a provision that contribution should be paid by motor-omnibus proprietors towards road maintenance in each local area in which such conveyances run, and that the tramways undertakings, failing such contribution being made, should not be responsible for making good repairs necessitated by the running of the vehicles. The Association is of opinion that, under existing conditions, the greater part of the repairs necessitated by the running of motor-omnibuses falls upon tramways undertakings under the provisions of the Tramways Act, 1870, and considers it manifestly unjust that tramways should be held liable to construct, maintain and repair roads damaged by competing vehicles which, in most instances, are not even rated in the district.

L.C.C.—At a meeting of the L.C.C. on Tuesday, Mr. W. Whitaker Thompson, chairman of the Highways Committee, stated, in reply to questions regarding the introduction of the G.B. surface-contact system in the Mile End Road, that some cars were being equipped by the Committee, as the contractors had not carried out the work as speedily as had been hoped.

The Highways Committee reported having given consideration to the question of the transport of sand, plant and other stores and materials between different points on the tramways, and it was advised that the work could be more economically accomplished by the use of electrical vehicles run on the tramways than by petrol or steam lorries. On the recommendation of the Committee the Council sanctioned an expenditure of £3,000 for the provision of six vehicles.

The Parliamentary Committee, whose previous report on the subject was referred back, presented a fresh report in relation to the Bill promoted by the Metropolitan Electric Tramways, Ltd., in regard to the construction of tramways in Harrow Road near Lock Bridge, to a point near Edgware Road. The Committee recommended the Council not to offer any opposition to the Bill subject to the insertion of clauses providing (1) that the powers thereunder respecting the tramway extension should not be exercised unless and until the Council gave its consent; (2) that in the event of the Council promoting a Bill hereafter for the construction of tramways along the same route, the company should not oppose the proposal, except on details; and (3) for the protection of the Council's property and interests.

The Council postponed for a week the consideration of a recommendation to sanction an expenditure of £45,330 for the introduction of the overhead trolley system on the tramways from Wanless Road, Loughborough Junction, to Norwood, and of £7,000 for the anchoring of track rails.

A sum of £179,450 is to be spent on 175 additional tramcars, all of the double-deck pattern.

It is proposed to make tramway tickets on the Hammersmith and Harlesden lines available for admission to the Franco-British Exhibition by payment of an additional 1s. The Council is to receive a commission of 5 per cent. on all such tickets sold. A tramway siding, costing £1,950, is to be erected by the Council in the Exhibition grounds.

Camberwell.—The B.C. has been informed by the B. of T. that it has consented to the electrification of the L.C.C. tramways (partly situated within the borough) from Brixton Road *via* Gresham Road and Coldharbour Lane, to Denmark Hill.

London's Electrical Debt.—The statistical officer of the L.C.C. has prepared a return relating to the debt of the various London local authorities outstanding on March 31st, 1907. It appears that the net debt attributable to the tramways on that date amounted to £6,108,906, whilst the debt of the Borough Councils for electric lighting reached a total of £5,296,496.

Stalybridge.—At the monthly meeting of the Stalybridge, Hyde, Dukinfield and Mossley Joint Electricity Board on Wednesday, Mr. W. E. Wood (chairman of the Finance Committee) reported a loss of over £10,000 on the working of the tramways. They had, however, reached the high-water mark on the interest and sinking fund accounts, and the concern would now lead up to a great success.

TELEGRAPH and TELEPHONE NOTES.

Anglo-French Telegraphs.—The Paris correspondent of the *Daily Telegraph* states that the Under-Secretary of State for Posts and Telegraphs has promised that the subject of an important reduction in Anglo-French telegraphic rates shall have his immediate attention. He has intimated that the reduction in the Paris-London telephone rates will be very considerable. The exact rate is not yet fixed, but the charge will probably be 5 fr. or 6 fr. per conversation of 3 minutes instead of 10 fr. as at present.

Russia.—According to the *Zeitschrift für Post und Telegraphie*, the Russian Emperor has sanctioned the construction and working of telephone lines between Moscow and Nijni Novgorod, Moscow, Iwanowo, Woznessensk, Charkow and Jekaterinoslow and Charkow and Bachmut, under a concession to be granted for 18 years, at the expiration of which time the lines become the property of the Government.

Technical Staff Conferences.—The *Journal of Posts and Telegraphs*, published by the Russian Administration, announces that an International Conference of the technical staff of the Posts and Telegraphs department will take place at Buda-Pesth on September 21st or 26th next.

Telegraphic Interruption and Repairs:—

Cables.		Interrupted.	Repaired.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo	Closed	Jan. 12, 1906	
Tarifa-Tangier		Jan. 18, 1904	
Port Arthur-Chifu	(Closed)	Mar. 9, 1904	
Cadiz-Teneriffe		April 22, 1908	May 5, 1908
Chio-Tenedos		May 7, 1908	
Cayenne-Saïnas		May 9, 1908	
Landlines.			
Puerto-Barrios		Aug. 2, 1902	

Wireless Telegraphy.—The Post Office Circular contains a notice that telegrams intended for transmission to Montreal by the Marconi Co.'s wireless service (*vid* Clifden) can only be accepted at post offices as inland telegrams, addressed "C/o Expanse, Galway." If replies to inward telegrams received by the company's service are prepaid, the prepayment covers, so far as the Post Office Department is concerned, the inland transmission only, and the reply must be addressed, like other outward telegrams.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Perth.—September 7th. 650 telephone wall sets, 150 table sets, various switchboards, other instruments, protectors, &c., for the Postmaster-General's department. Some particulars can be seen at the Electrical Review office.

Melbourne.—May 25th. Flame and ordinary arc lamp carbons, for the City Council. See "Official Notices" May 8th.

South Australia.—June 3rd. Telephone material, instruments, and switchboards for the Postmaster-General's department, Adelaide. Specification, &c., can be seen at the Electrical Review office.

MELBOURNE.—August 26th. Installations for wireless telegraphy at the following places:—Cape York, Thursday Island, Goode Island, Port Moresby, Fremantle, required by the Commonwealth Postmaster-General's department. Specification can be seen at the office of the ELECTRICAL REVIEW.

MELBOURNE.—July 3rd. One 500-KW. motor generator, for the electricity supply department. See "Official Notices" May 8th.

QUEENSLAND.—June 1st. Battery glassware, material, chemicals, tools, &c., for the Postmaster-General's department, Brisbane. Specification can be seen at the ELECTRICAL REVIEW office.

NEW SOUTH WALES.—June 10th. 8 tons H.D. copper wire, copper tape binding, 1,300 insulators, 2,000 cross-arms for the Postmaster-General's department, Sydney. Specification, &c., can be seen at the ELECTRICAL REVIEW office.

SYDNEY (N.S.W.).—August 12th. Tenders to Deputy Postmaster-General. Branching metallic multiple magneto switchboard at Mosman. Specification can be seen at ELECTRICAL REVIEW office.

Bermondsey.—May 18th. Boiler, steam dynamo, condenser and cooling tower, for the B.C. See "Official Notices" May 1st.

Bristol.—Power distribution boards, sub-station and other switchgear, also extension of galleries at Avonbank, for the Electrical Committee. See "Official Notices" May 8th.

Brussels.—May 27th. Underground cables for traction. Director-General, Société Nationale des Chemins de Fer Vicinaux, Rue de la Science, 14, Brussels.

Croydon.—May 20th. Lighting, telephones and fire-alarms, for three ward blocks at the Croydon Mental Hospital extension. See "Official Notices" May 8th.

Dartford.—June 3rd. Surface condensing plant, for the U.D.C. See "Official Notices" to-day.

Dartford.—June 9th. Oils, meters, house service cable, &c., for the U.D.C. See "Official Notices" May 8th.

Derby.—Cable for the electricity department. See "Official Notices" May 1st.

Dudley.—May 25th. Oils for the electricity department. See "Official Notices" to-day.

France.—May 30th. The Director of Hydraulic Works of the French Navy, at Toulon, is inviting tenders for an installation of electric lighting at the Naval coal depôt at that port.

France.—June 18th. The municipal authorities of Paris are inviting tenders for the supply and erection at the Colombes sewerage station, at Gennevilliers, of two sets of centrifugal pumps and three-phase electric motors.

Germany.—Tenders are about to be invited by the municipal authorities of Sprendlingeir for the establishment of an electric tramway in the town.

Glasgow.—Extra high-tension testing apparatus for the T.C. electricity department. The Engineer.

Handsworth.—May 25th. Low-tension distributor cables for the U.D.C. Specification at generating station, Soho Road.

Hanley.—Arc lamps and lamp columns for the Corporation. See "Official Notices" May 8th.

Italy.—The Italian State Railway authorities are about to invite tenders for the conversion of the Giovi Railway to electric traction.

Kilmarnock.—May 25th. Lancashire boiler for the Corporation electricity works. See "Official Notices" to-day.

London.—May 26th. Two electrically-driven centrifugal pumps, &c., for the L.C.C. generating station at East Greenwich. See "Official Notices" May 8th.

Rawtenstall.—May 29th. Track boosters, low-tension D.C. and high-tension A.C. switchboards, for the Corporation. See "Official Notices" to-day.

Salford.—May 25th. Cooling towers, tanks, pumps and pipe-work for the electricity department. See "Official Notices" May 8th.

Spain.—Tenders have just been invited by the municipal authorities of Abanto y Ciervana (province of Vizcaya) for the concession for the establishment of a central electric lighting station in the town, and for the working of the same during a period of five years.

Spain.—May 31st. Electric light and power installation for the Board of Works of the port of Tarragona. Board of Trade, Commercial Intelligence Branch.—*Board of Trade Journal.*

Stockport.—Automatic point-controllers, for the Corporation. See "Official Notices" to-day.

Walsall.—May 29th. Condensing plant for the Electricity Department. See "Official Notices" May 8th.

Worthing.—May 25th. Condensing plant, pumps and piping for the Corporation. See "Official Notices" to-day.

CLOSED.

Cardiff.—The Council of the University College of South Wales and Monmouthshire has accepted the tender of Messrs. R. Alger & Sons, Newport, for the electrical installation of the new college in Cathays Park, Cardiff, for £2,048, exclusive of lamps.

Colchester.—The T.C. has accepted the tender of Messrs. J. Yates & Co., of Birmingham, for tramway wheel tires.

Derby.—The T.C. has accepted the tender of Messrs. Johnson & Phillips, Ltd., for bitumen cable (£84), and of the British Insulated and Helsby Cables, Ltd., for high-tension cable.

The Tramways Committee has accepted the tender of Messrs. Edgar Allen & Co. for the construction of a new crossing at the junction of London Road and Midland Road. A track grinder is to be supplied by Messrs. George Robson & Co. (£85).

Eccles.—The T.C. has accepted the following tenders:—

E. Heaton & Sons.—Lancashire boiler and superheater, £601.
Browett, Lindley & Co.—210-KW. steam engine, alternator and exciter, £1,267.

Devonport.—The Corporation Electric Power Committee has accepted the tender of the Underfeed Stoker Co. for mechanical stokers, at £1,375.

France.—The French Post and Telegraph Authorities in Paris have just placed contracts for the supply of copper wire (gutta-percha and paraffined cotton-covered) as follows:—MM. Houry & Filleul-Broby, Paris, 200 kilometres; M. de la Mathe, of Saint Meurice (Seine), 200 tons.

Leek.—The U.D.C. has accepted the tender of Messrs. Mather & Platt, Ltd., for an engine and dynamo, at £2,650.

London.—MARYLEBONE.—The B.C. has accepted tenders for annual supplies of stores, &c., for the Electricity Department from the following firms:—

T. & W. Farmiloe.—Oil, red lead, &c.
W. H. Wilcox & Co.—Vaseline, &c.
Naylor Bros.—Varnish and enamel.
Pryke & Palmer.—Resin, knives, paraffin, &c.
Croager Bros. and F. Bird & Co.—Tools.
Witty & Wyatt.—Asbestos tubing.
J. Knox & Co.—Saws, &c.
J. F. & G. Harris.—Meter boards, &c.
H. W. Gilbart.—Creosoted troughing.
W. McGeoch & Co.—Adhesive tape.
St. Helens Cable Co.—Rubber gloves.
B. I. & Helsby Cables.—Fuse wires.
Tulley & Straker.—Mica.
Baxter & Caunter.—Ceiling roses.
Pope's Electric Lamp Co.—Radiator lamps.
General Electric Co.—Steel conduit.

HAMMERSMITH.—The B.C. has received the following tenders for main switchgear:—

Johnson & Phillips.—(*a*) switchboard, £1,401; (*b*) cubicle work, no 1½ in. slates; (*c*) selector switch in oil, £50; (*d*) total without feeders, £1,451; (*e*) 20 feeder panels, £500; (*f*) complete contract, £1,951.
Johnson & Phillips (alternative tender).—(*a*) £1,401; (*b*) £29; (*c*) £50; (*d*) £1,480; (*e*) £500; (*f*) £1,980.
Switchgear, Ltd. (provisionally accepted).—(*a*) £1,344 10s.; (*b*) £130; (*c*) £70; (*d*) £1,544 10s.; (*e*) £470; (*f*) £2,014 10s.
Spagnoletti, Ltd.—(*a*) £1,330; (*b*) £70; (*c*) £100; (*d*) £1,500; (*e*) £500; (*f*) £2,000.
British Westinghouse Co.—(*a*) £1,344 10s.; (*b*) included in total; (*c*) included in total; (*d*) £1,534; (*e*) £674; (*f*) £2,018.
Cowans, Ltd.—(*a*) £1,575; (*b*) £120; (*c*) £118; (*d*) £1,818; (*e*) £316; (*f*) £2,129.
Ferranti, Ltd.—(*a*) £1,519; (*b*) £562; (*c*) £200; (*d*) £2,281; (*e*) £700; (*f*) £2,981.

The Electricity and Lighting Committee, reporting on the tenders, stated that a letter received from Messrs. Johnson and Phillips in effect materially increased the total amount of their tender, and although the company had since virtually agreed to adhere to their original tender, the Committee did not think the Council would be justified in further considering it. Messrs. Spagnoletti, Ltd., had also written, reducing the amount of their tender to £1,969, but as this was not received until after a recommendation to the Council setting out particulars of the various tenders received, the Committee decided that permission could not be given for the amending of the tender. The provisional acceptance of the tender of Messrs. Switchgear, Ltd., is subject to their undertaking to deliver the plant not later than July 31st.

The following tenders were received for steam piping required for the extension scheme:—

John Spencer, Ltd., welded on flanges (provisionally accepted)	£220
Aiton & Co., welded on branches	245
John Spencer, Ltd., riveted on flanges (alternative)	255
Rosser & Russell, riveted on flanges	261
Aiton & Co., riveted on branches (alternative)	263
Stewarts & Lloyds, welded on flanges	290
Edward Le Bas & Co., riveted on flanges	303
Babcock & Wilcox, weldless mild steel	330

For the supply of iron flues, air heaters and hot-air ducts, required in connection with the plant extension scheme, the following quoted:—

Meehan & Sons (provisionally accepted)	£710
John Fraser & Sons	969
Rosser & Russell	1,050
Thames Ironworks	1,350

For boiler mountings the tenders received were :—

Hopkinson & Co. (provisionally accepted)	£189 11

Dowrance & Co. and Templer & Rance also quoted.

The following tenders were received for battery boosters and switchboards :—

Premier Accumulator Co (provisionally accepted)		£939
Electrical Power Storage		977
Tudor Accumulator Co.		979
Electrical Power Storage		985
D.P. Battery Co.		1,004
Chloride Electric Storage		1,012
Hart Accumulator Co.		1,193
Pritchetts & Gold	battery	788
Accumulator Industries	battery	946
Hagen Accumulator Works	battery	1,010
W. C. Rooper & Co.	battery	1,422

The following quoted for free-burning coal :—

	3 months' contract.	12 months' contract.
	s. d.	s. d.
Spenser Whatley, Ltd., Selston main seam small	11 5	11 5
Kaye, Son & Co., Pinxton nutty slack	12 4	12 4
" " Pinxton pea nuts	14 1	14 1
Spenser Whatley, Ltd., Selston main seam peas	15 2	15 2
Cory Bros. & Co., Pewei Pyber unwashed.. ..	15 4	14 10
E. Foster & Co., Mardy..	15 9	15 9
Main Colliery Co.	(accepted)	—
Graigola and Victoria	15 10	15 10
H. B. Pring, Primrose	15 11	15 11
Cory Bros. & Co., Pentre, Rhondda Valley ..	16 4	15 10
Speakman & Son, Corrwg Vale	14 6	16 3
Dinham, Fawcus & Co., Dynnevor Duffryn ..	16 6	16 6
Hinchliffe & Co., Sgwborwen	16 8	16 8
Lindsay Blee & Co., Moontown	16 11	16 11
T. A. King, Grovesend Longerwich..	17 3	17 0
" " Fernhill	17 0	17 0
Hinchliffe & Co., Ynisfair	17 4	17 4
Waddell & Co., Phœnix Glyncorrwg	18 0	13 0

Malvern.—The U.D.C. has accepted the tender of the Reason Manufacturing Co. for meters, and that of Callender's Cable and Construction Co. for cables.

Middlesbrough.—The T.C. has accepted the tender of Callender's Cable and Construction Co. for the supply of mains, at £1,642.

Newcastle-under-Lyme.—The T.C. has accepted the tender of Messrs. Bagguley & Wood, a local firm, for the supply and laying of 1,010 yds. of three-wire main, at £579.

Rhyl (N. Wales).—The Bradford Electrical Engineering Co., Ltd., have received the contract from the U.D.C. for the electric lighting of the new Promenade gardens and shelters, including all arc lamps, fittings, switchboard, &c.

Stalybridge.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has accepted the tender of Messrs. Bolckow, Vaughan & Co., Ltd., for two tons of fish-plates.

Sydney (N.S.W.).—We understand that Messrs. H. McKenzie & Co., of Sydney, have recently placed an order for a special fixed electric cantilever crane, capable of dealing with loads of 30 cwt. at a radius of 100 ft., to Messrs. Applebys, Ltd. The crane is to be fitted with lifting, slewing and traversing motions, each worked by a separate motor, and all controlled from a cabin fixed on the cantilever, the height of the underside of which will be 50 ft. The crane will command a very large area, and its introduction will, it is anticipated, go far to solve the problem of timber handling, which is a pressing question in New South Wales.

Tonbridge.—The U.D.C. has accepted the following tenders :—

Siemens Bros. & Co.—Dynamo, spare armature and condenser, £976.
Korting Bros.—Pipework and pumps, £314.
Walsall Electrical Co.—Switchboard, &c.

Wolverhampton.—The E.L. Committee has accepted the following tenders :—

British Electric Transformer Co., Ltd.—Two three-phase transformers (100 kw. each); inclusive price £232.
Thos. Parker, Ltd.—One boiler feed pump, £218.

West Ham.—The T.C. has provisionally accepted the following tenders for annual supplies for the electricity department :—

India-Rubber-Covered Wires.—Liverpool Electric Cable Co., Ltd.; Pluttc, Scheele & Co.; Armorduct Manufacturing Co., Ltd. (flexible wires, single vulcanised).
Electrical Fittings.—Evered & Co.; Electrical Co., Ltd.; Armorduct Manufacturing Co., Ltd.; G. Straus & Co., Ltd., G. Braulik; British Insulated and Helsby Cables, Ltd.; Verityz, Ltd.; General Electric Co., Ltd.
Engine Room Stores.—Geo. Angus & Co., Ltd.; James Gibb & Co., Ltd.; H. Edmunds & Co.; Manufacturers' Agency Co., Ltd.; Frederick Bird and Co.; Middleton Bros.; Pryke & Palmer; Wiggins & Ribll.

Only one tender was received for chemicals, and this is not to be accepted; but the various articles are to be obtained at the following agreed prices :—

F. W. Berk & Co., Ltd.—Sulphate of alumina, £4 5s. per ton.
Middleton Bros.—Carbonate of soda, £5 5s. per ton; caustic potash, £1 8s. per ton; glycerine, 6s. 9d. per gallon; calcium chloride, 10s. per cwt.

Yarmouth.—The Corporation on Tuesday accepted the tender of the Tredegar Iron and Coal Co. for the supply of 3,500 tons of Welsh steam coal for the electric light works, at 15s. 6d. per ton f.o.b. Cardiff.

CONTRACTORS' COLUMN.

[The following information is published in the interests of electrical contractors and others who are seeking for openings for new business. Considerable expense is incurred in the production of this column, and every care is taken to ensure that the information is new and accurate, but it will be understood that in a matter where so many correspondents are engaged, and where the amount of information to be handled is very large, this cannot always be guaranteed. If alleged inaccuracies are reported to the Editors, they will be fully investigated.]

ABERCARN (Mon.).—Hall, shops, &c., for the Presbyterian Church of Wales. Habershon, Fawckner & Co., architects, 41, High Street, Newport (Mon.).

ABERDARE.—Two semi-detached villas for L. N. Williams; villa, T. Roderick, architect, Aberdare.

ABERDEENSHIRE.—Alterations on farm steading at Woodend. Messrs. Chalmers, Golden Square, Aberdeen.

ABERTILLERY (Mon.).—Welsh Calvinistic Methodist Church.

ABERYSTWYTH.—Bungalow for Mrs. A. J. Hughes on Buarth, Aberystwyth. G. T. Bassett, architect, Aberystwyth.

ALDERLEY EDGE (Lancs.).—Additions to "David Lewis" Epileptic Colony. G. H. Willoughby, architect, York Street, Manchester.

ALDERSHOT.—Children's wing at the Aldershot Hospital; hall in Grosvenor Road for the Christian Science Society; additions to St. Joseph's Presbytery for Rev. F. O'Farrell.

ALFRETON.—Wesleyan Church at Tibshelf. J. E. Goodacre, architect, 4, Stockwell Gate, Mansfield.

APPLEDORE (Devon).—Houses, Richmond Road, for A. B. Cook; Meeting Street, for Mr. Tamlyn.

ASFORDBY (Leicestershire).—School for the Leicestershire C.C. Education Committee. E. Shelbourn, architect, Melton Mowbray.

ASHTON-UNDER-LYNE.—Eleven houses in Katherine Street. Local Co-operative Society.

BALLAGHADEREEN (Ireland).—Alterations to the cathedral for the Most Rev. Dr. Lyster, Lord Bishop of Achonry. D. W. Morris, surveyor, 68, Harcourt Street, Dublin.

BARNET.—Proposed school. Architect to the Education Committee, Herts, County Council, St. Albans.

Two houses in Byng Road. C. T. Anstee, 68, Union Street, Barnet, Herts., builder.

(East).—Two houses, Margaret Road. A. E. Prentice, builder, Lancaster Road, New Barnet, Herts.

BEAFORD (Devon).—Alterations and additions to The Warren for Major Kingchurch. Harbottle Reed, architect, 19, Castle Street, Exeter.

BEDFORD.—Additions to Shire Hall (in place of Education Committee's offices recently burnt down), cost not to exceed £4,500. W. H. Leete, county surveyor, Shire Hall, Bedford.

BELFAST.—New Moravian Church in contemplation at Cliftonville; rebuilding workshop for Industrious Blind (recently destroyed by fire).

BEXHILL.—Additions to Cooder House, Little Common, for C. W. Jackson. J. B. Wall, architect.

BIRMINGHAM.—Post Office premises in Great Hampton Street. Postmaster, Birmingham.

Public baths at corner of Nechells Park Road and Aston Church Road, Nechells (£22,000).

(Black Heath).—Congregational Church in Green Lane, adjoining present building (£2,500). Trustees.

BLACKBURN.—Two houses, Herbert Street, H. Harrison; 12 houses for Simpson & Duckworth; two houses, Winchester Street, J. Foster; storeroom, Dandy Walk, for the Blackburn Billposting Co.; new printing works, J. Highton & Son; warehouse, Whalley Road, T. Forrest.

BLACKPOOL.—New United Methodist Free Church.

BOCKING.—Vicarage in connection with St. Peter's Church. Rev. H. J. Shilding, vicar.

BOLTON.—Villas, Chorley New Road, Heaton. J. C. and F. Woods, builders, Bolton.

BOURNEMOUTH.—Houses, Lucas Road, for Rev. E. Hall, E. E. Clark, architect; house and sawmill, Richmond Road, for J. G. Jacobs, G. W. Jackson, architect; house and shop and alteration to house, Ashley Road, for Mrs. Hart, E. van Schapdael, architect.

(Springbourne).—Public library in Holdenhurst Road. Hawker and Mitchell, architects, St. Peter's Chambers, Bournemouth.

BREDBURY (Cheshire).—Houses, Hill Street, Woodley, for W. Lucas; houses and shop, Bent's Lane, for the Woodley Co-operative Society.

BRIDLINGTON.—Detached residence, Belgrave Road, for Capt. C. J. Blenkarn. J. Earnshaw, architect, Carlton House, Bridlington.

BRYNMAWR.—Business premises for A. T. Watkins. Henry Waters, architect, Market Chambers, Ebbw Vale.

CAMBRIDGE.—City and County School and School of Arts and Crafts (£10,879). Bell & Sons, builders, Castle Street, Cambridge.

CANNOCK (Staffs.).—Two houses at Green Heath; and four at Hednesford.

CARDIFF.—Twelve houses at Pwllypant. J. H. Phillips, architect, Olive Chambers, Windsor Place, Cardiff.

CHADWELL HEATH (Essex).—Parochial Hall. Rev. E. J. Colnett, Vicar of the Parish.

CHEADLE.—Houses, Victoria Avenue, Cheadle Hulme, for C. Gradwell; Woodfield Road, for T. Forshaw.

CHRISTCHURCH.—Electric lighting of the Workhouse and Cottage Homes under consideration. A. Druitt, Clerk to the Board of Guardians.

CLEETHORPES (Lincs.).—Infants' block at the Elliston Street Schools, for the Lindsey C.C. Scorer & Gamble, architects, Bank Street Chambers, Lincoln.

COLCHESTER.—Grammar School (£8,600). Essex Education Committee.

COLWYN BAY.—New Church, King's Road. Canon Roberts, Vicar.

CRESWELL (Derbyshire).—Hotel for the Worksop and Retford Brewery Co., Ltd., Worksop.

CROYDON (Shirley).—Bandroom and Gymnasium at Wickham Road Schools, for the Guardians of the Parish of Bermondsey. A. H. Newman, architect, 91, Tooley Street, S.E.

CREWE.—Six houses in Denver Street. Councillor J. Jones.

DARTFORD.—Additions to the Wesleyan Church (£3,000 to £4,000).

DARWEN.—Proposed new Conservative Club premises for the Chapels district.

DEWSBURY.—Houses, West Town, for T. Lawson; Huddersfield Road, for Wm. Crabtree & Sons.

DOWNHAM.—Church at Stow Bridge. E. Douglas Hoyland, architect, London; Dye & Allen, builders, King's Lynn.

DISS.—Business premises at Botesdale. G. W. Leighton, architect, 6, Princes Street, Ipswich.

DOVER.—Alteration to the York Street Almshouses. T. B. Harry, clerk, Dover Almshouse Charity, 4, St. James's Street, Dover.

DUDLEY.—Bank at Sedgley for the United Counties Bank, Ltd. John Dallow, builder, Blackheath, Worcestershire.

DURHAM.—Houses, High Wood View, for Beaven & Clark, and Mr. Jopling.

EASTBOURNE (Hampden Park).—Houses, Lotbridge Road, for D. Hookham; C. M. Wood, architect; Rosebery Avenue, for L. C. Stevens; A. H. Burtenshaw, architect; Lotbridge Road, for T. Beal; Mitchell & Ford, architects; 58 in Hampden Avenue (a new road), for T. Beal, Mitchell & Ford, architects.

Pavilion, Dittons Road, for H. Palmer, A. Huggett, builder; houses, Milton Road, for J. Pelling; houses, Prentice Road, for Miller and Selmes, C. Crisford, architect; pavilion, Eastdean Road, for the Eastbourne Downs Golf Club, P. D. Stonham, architect; workhouse and infirmary on The Hinds, Willingdon, for the Board of Guardians (£36,000).

EASTLEIGH.—Additions and alterations to premises and new bakery in Grantham Road, for the local Co-operative Society.

EDINBURGH.—Proposed alteration to St. Columba's Free Church, Johnston Terrace (£2,500). J. Burnett & Son, architects, Glasgow.

Extension of premises for the Royal College of Surgeons, Nicolson Street. Rowand Anderson & Paul, architects, 16, Rutland Square, Edinburgh.

EXETER.—Alterations and additions to 7, High Summerlands, for the Guardians of the Poor. R. M. Challice, architect to the Guardians, 14, Bedford Circus, Exeter.

FALKIRK.—Proposed extension of High School (£4,000). Clerk of School Board, Falkirk.

FARNHAM.—Observation block for the Farnham Joint Isolation Hospital Committee. W. J. Wells, architect, 112, West Street, Farnham.

FROME.—Proposed alterations and additions to the Old Vicarage, Buckland Dinham.

GILLINGHAM (Kent).—Extension of business premises for G. H. Leavey and Co., Ltd.; houses, Rock Avenue, W. Dobson, builder, Ferndale Road, Gillingham; Watling Street, for Clifford & Co., E. F. Cobb, architect, Rochester; E.L. installation at the Prince of Wales Hotel, W. J. Binfield, owner.

GLASGOW.—Infant school at Shettlestone.

GOOLE.—Infectious diseases' hospital at Hook for the Goole Joint Hospitals Board.

GRIMSBY.—Alterations to the Central Restaurant, 95, Cleethorpes Road. H. J. Whyatt, borough surveyor, Town Hall Square, Grimsby.

HALESOWEN.—Salvation Army barracks (to seat 600), Cakemere, near Blackheath.

HALIFAX.—Additions to mill at Barkisland for J. Shaw & Co.

HALTWHISTLE (Northumberland).—Extensive additions to Co-operative premises. E. Hastewell, architect, Haltwhistle.

HANLEY.—Six houses in Birches Head Road, E. Roberts; alterations to shops, 63 and 65, Stafford Street, for Lipton, Ltd.

HANWELL.—Development of Stud Farm estate. W. O. Vizard, 10, Norfolk Street, W.C., solicitor.

HARROW.—Secondary school at corner of Kenton and Sheepcote Roads. H. G. Crothall, Education architect, Middlesex Guildhall, Westminster, S.W.

HARTHILL (Lanarkshire).—Public hall (seat 650). W. Magee, Harthill.

HAYLE.—Residence for W. Rutter, Clifton Terrace. Wearne & Vercoe, builders, Hayle.

Restaurant, for Mr. Harris, and conversion of premises into bank for the Capital and Counties Bank. Harris & Jory, builders, Hayle.

HERTFORD.—Large residence in the Wash, Ekins & Co., builders, Hertford; strong room for Herts C.C. (£1,016).

HOUGHTON-LE-SPRING (Co. Durham).—House and shop, Newbottle Street, for J. C. Hudson, Sunderland Street, Houghton.

HUDDERSFIELD.—Works in Viaduct and Fountain Streets, for Rippon Bros., automobile engineers. J. Berry, architect, 3, Market Place, Huddersfield.

Four houses in Leeds Road North. J. H. Hall, architect, Market Buildings, Market Street, Huddersfield.

HUTTON (Essex).—Country residence (£869). Hugo R. Bird, St. Thomas's Gate, Brentwood, architect.

ILFORD.—Parish room at Uphall (£1,750). E. T. Dunn, architect, 20, Mansfield Road, Ilford.

ILFRACOMBE.—Houses, Hillsboro', for W. Pile, Fore Street.

KEITH.—Additions and alterations on property for J. Symon, painter. D. J. Corrigall, architect, Keith.

KETTERING.—Contemplated extension to premises of the Kettering Co-operative Society.

KINGSTON.—Proposed premises for Working Men's Club. J. M. R. Francis, J.P., president.

KIRKBY-IN-ASHFIELD.—Houses, Diamond Avenue, for W. H. Woods; Balfour Street, for Gibson & Sharman; Cookson Street, for Mr. Scothern.

LANCASTER.—Wesleyan Methodist Church on the Greaves Estate.

LEATHERHEAD.—Housing scheme contemplated by the local Co-operative Society.

LEIGH (Lancs.).—New colliery at Astley, for the Pilkington Coal Co.

LEYLAND.—Four houses, George Street. Brailsford & Son.

LINCOLNSHIRE.—Primitive Methodist Chapels at Scunthorpe and Ingoldmells.

LINTHWAITE (Yorks).—Five houses at Smithriding. Lunn & Kaye, architects, Milnsbridge and Huddersfield.

LIVERSEDGE.—Stabling and warehouse, Belmont Street, for J. Pickles and Sons; houses, Smithies Lane, Open Bank Road and Milton Row, for John Crossley, jun.

LLANELLY.—Y.M.C.A. building in Town Hall Square (£5,000).

LOCHORE (Fifeshire).—School for the Ballingtry School Board. J. Henderson, clerk to the Board, 5, Douglas Street, Dunfermline.

LONDON (Bermondsey).—With reference to last week's notice concerning the electrical installation at Greenslade & Co.'s premises in Crucifix Lane, we find that the installation has been completed for some months. The question has lately been under consideration of arranging special terms for supply, and it was due to this fact that the item was inadvertently included.

(Canning Town, E.).—Schools and class-room, St. Gabriel's Church. J. R. Moore-Smith, architect, 14, Union Court, E.C.

(Plaistow, E.).—Store, &c., Barking Road. Clemens Bros., builders, York Road, East Ham.

(Battersea, S.W.).—Building, Strath Terrace. W. Hammond, builder, 72, York Road, S.W.

(Holborn).—Proposed addition to Children's Hospital, Great Ormond Street. C. E. Barry, architect, Parliament Mansions, Westminster.

(Wimbledon).—Installation of electricity for power purposes at premises of J. S. Downham, Hill Road.

(St. John's Wood, N.W.).—Studio, 90, Carlton Hill. E. G. Dawber, 22, Buckingham Street, Strand, W.C., architect.

(Finchley Road, N.).—Four shops. A. W. Armstrong, Lissenden Gardens, Highgate Road, N.W.

(Clapham, S.W.).—Development of new street. W. C. Poole, architect, 62, Belleville Road, Wandsworth Common, S.W.

Greenwich, S.E.).—Four houses, Straightsmouth. A. Roberts, architect, 92, London Street, Greenwich, S.E.

LONDON (Bermondsey, S.E.).—Dwelling-house, Jamaica Road. W. Downs, builder, Hampton Street, Walworth, S.E.

(S.W.).—New wing at the Tate Gallery (gift of J. J. Duveen, esq.)

(Wimbledon).—Shops and flats in High Street. Thompson and Pomeroy, 49, Hill Road, Wimbledon, architects.

(Wimbledon).—Church, corner of Durham and Spencer Roads. Vicar of Wimbledon.

(E.C.).—Rebuilding the London Institution, Finsbury Circus.

(Finchley Road, N.).—Buildings. Wimperis & Best, architects, 6, Vigo Street, W.

(Wandsworth, S.W.).—Building, 85, Upper Tooting Park. A. Wellings, surveyor, Leigham Court Road, S.W.

(Islington, N.).—Sunday school and institute. A. Conder, architect, 9, Bridge Street, S.W.

(Hampstead Road, N.W.).—Shops. Hovenden & Barber, surveyors, 30, Bishopsgate Street, E.C.

(Islington, N.).—Building, York Road. Lovegrove & Papworth, architects, Town Hall Chambers, 374-8, Old Street, E.C.

(St. Pancras, N.W.).—Building in Euston Road. Dunk & Bousfield, architects, Billiter Square Buildings, E.C.

(Finsbury).—Building in Sekforde Street. W. H. Woodroffe, architect, 57, Lincoln's Inn Fields, E.C.

(Battersea, S.W.).—Shop, St. John's Hill. R. H. Weymouth, architect, 3, Victoria Street, S.W.

(Wandsworth, S.W.).—Buildings. E. J. Partridge, architect, Bank Chambers, Richmond.

(Rotherhithe, E.).—Buildings, Cow Lane. J. J. Freeland, architect, 19A, High Street, Clapham, S.W.

(E.C.).—Building, Cloak Lane, Dowgate Hill and Cannon Street. Ford, Son & Burrows, architects, 70a, Basinghall Street, E.C.

(Wimbledon).—Development of road off Arthur Road. Ryan and Penfold, Wimbledon Park, Wimbledon, agents.

(Temple Avenue, E.C.).—Alterations to offices, &c. W. Nash, builder, Childers Hill, Deptford.

(Throgmorton Street, E.C.).—Partial rebuilding of No. 33.

(Piccadilly Circus, W.).—Rebuilding shop, &c., in Glasshouse Street. Patman & Fotheringham, builders, 290, Liverpool Road, Islington.

(Grosvenor Square, W.).—Rebuilding mansion at corner of Grosvenor Road. Higgs & Hill, builders, South Lambeth Road, S.E.

(W.).—Shops, showrooms, offices, &c., Berners Street and Castle Street. Holloway Bros., builders, Westminster Bridge, S.W.

(Finsbury).—Buildings. R. Peters, architect, 73, Wool Exchange, E.C.

(Islington, N.).—Working class dwellings. Joseph & Smithem, architects 83, Queen Street, Cheapside, E.C.

(Wimbledon).—House and shop, Revelstoke Road, for E. T. Manley, The Broadway, Wimbledon, dairy farmer.

(Wimbledon Common).—Alterations and additions to premises in Camp Road and West Side. R. A. Hinds, Wood Nook, Wimbledon Hill, architect.

(Greenwich, S.E.).—Five houses, Lower Park Street. Capt. Warburton, Greenwich Hospital estate.

(Paddington, W.).—Alterations to workhouse. Architect, c/o Clerk to the Guardians, Harrow Road, W.

(Southwark Street, S.E.).—Building on site of 49. W. H. Rogers, "The Feathers," Hampton-on-Thames.

(Southwark, S.E.).—Building in Pontypool Place. J. Hoare & Son, 74, Blackfriars Road, S.E.

(Wimbledon).—Five houses in Ashen Grove. C. Barwell, "The Elms," Morden, Wimbledon, agent.

(Raynes Park).—Conversion of premises in Carlton Terrace, Coombe Lane, into shops. Whitehead Bros., 21, Hill Road, Wimbledon, builders.

(Euston Road, N.W.).—Shops, work-rooms, &c. G. Parker, Sumner Road, Peckham, builder.

(S.W.).—Alterations to 83 and 85, Knightsbridge. L. Sutton, builder, 351, Portobello Road, S.W.

(Camberwell, S.E.).—Addition to No. 2, Bassano Street. A. E. Mullins, architect, 48, Peckham Road, S.E.

(Camberwell, S.E.).—Warehouse, Nungate. H. J. Collis.

(S.W.).—Alteration to Nos. 34 to 44, Hans Crescent, for Harrods, Ltd. Holland & Hannen, builders, Hyde Street, Bloomsbury.

(West Green, N.).—Partial rebuilding of Christ Church. Vicar and Trustees.

(West Green, N.).—Salvation Army Citadel, Terront Road. Commissioner Hay, Congress Hall, Clapton.

MALVERN.—Residence, Wyche Road, for Shirley Baldwin. Cossins, Peacock and Bewlay, architects.

MANCHESTER.—Additions to Fairfield Moravian Church (£1,700).

Wesleyan Church at Burnage. Mr. Price, resident missioner.

(Cheetham).—Parochial Hall. Rev. S. Hailstone, St. Saviour's Church, Cheetham.

MIDDLESBROUGH.—Parochial Hall and Sunday Schools adjoining Linthorpe Parish Church (£4,000); Rev. J. W. Dales, vicar. New schools, at South Bank for the North Riding of Yorks C.C. W. H. Brierley, architect, 18, Lendal, York.

MINEHEAD (Somerset).—New steam laundry (near electric main). Mr Parker, builder, Minehead.

MIRFIELD.—Houses, St. Paul's Road, for J. S. Tadman; Greenside, for T. Hudson; Taylor Hill Lane, for J. D. Sykes; Northorpe Lane, for Mr. Bradbury.

MOTHERWELL (N.B.).—Extension of the Burgh Hospital.

NEATH.—New School at Lonlas, near Skewen, for Glamorgan C.C. T. Mansel Franklen, clerk to the Council, Westgate Street, Cardiff.

NEWCASTLE-ON-TYNE.—Additions to Walker Gate Hospital for the T.C. (£1,460).

NORTHAMPTON.—Rebuilding premises for Dover, Ltd., celluloid article manufacturers (recently destroyed by fire).

NORTHIAM (Sussex).—Houses, Ellis Bros., builders, Military Road, Rye, and A. Comport, builder, Northiam.

NOTTINGHAM.—Warehouse, Stoney Street, for Phelps & Whiteman, lace manufacturers; and premises for the Co-operative Society, equipped with electric lifts, &c.; W. V. Betts, architect, Basford, Nottingham.

OLNEY (Bucks.).—Congregational Sunday School.

OSWESTRY (Salop).—Houses, Oswald Road, for Messrs. Campbell; additions to premises, Leg Street, for Richard Jones; warehouse, Bailey Street, for John Minshall & Co.; houses, Garden City, Shrewsbury Road, for B. Taylor.

PENARTH.—House in Victoria Road, L. Robertson, architect, Cardiff; two houses in Grove Place, Messrs. D. Davis & Son, builders, Cardiff; extensions to the Penarth Electric Light Works, Manager, Penarth Electric Light Co., Penarth.

PICKERING (Yorks.).—Houses, Castlegate, for John Hirst.

PONTYCYMMER (Glam.).—Extension to premises of the Pontycymmer Industrial Co-operative Society. Wm. Thomas, secretary Pontycymmer, Glamorgan.

PORT TALBOT.—Two new shafts for the Whitworth Collieries Co., Ltd., Port Talbot.

RADCLIFFE (Lancs.).—Four houses in Ainsworth Road. J. Sellars, Son and Orrell, architects, Blackburn Street, Radcliffe.

Proposed Mission Room in Bolton Road district in connection with St. Thomas' Church, Radcliffe.

RAMSGATE.—Elementary schools in Lillian Road. Borough engineer.

RIBCHESTER (Lancs.).—Proposed reopening and starting of Buckley Wood Quarries. New company.

ROWLEY REGIS.—Improvements in lighting and ventilating at the Blackheath Council School. D. Wright, secretary to the Rowley Regis Education Committee, Old Hill, Staffs.

RUGBY.—Stabling at Cawston House for the Duke of Buccleuch.

ST. ANNES-ON-THE-SEA.—Houses in Headroomgate Road for T. Quinlan; pair of houses, for R. Crighton; houses, Lime Grove, for E. G. Bunce; St. David's Road South, for T. Seed; Cambridge Road, for Keenan & Parker; Bromley and Park Roads, for J. Heap and Sons.

ST. HELENS.—Roman Catholic Schools at Peasley Cross.

SALTBURN-BY-SEA.—Additions to residence. Kitching & Lee, architects, 21, Albert Road, Middlesbrough.

SEAFORD (Sussex).—Enlargement of the Girls' and Infants' Public Elementary School for the East Sussex Education Committee. J. Wood, county surveyor, County Hall, Lewes.

SHEERNESS.—Business premises at Eastchurch for the Co-operative Society. Secretary, Co-operative Society, 94, High Street, Sheerness.

SHEFFIELD.—New church at Grindleford Bridge. E. A. Sutton, architect, Bromley House, Nottingham.

SHREWSBURY.—Congregational Church on Coton Hill.

SOUTHAM (Warwickshire).—Improvements at the Police Station (£192). F. G. Watson, contractor.

STOKE-ON-TRENT.—Business premises at Talke for the Butt Lane Co-operative Society, Ltd. Arthur Cotton, architect, Audley (Staffs.).

SWANSEA.—Rebuilding business premises in Llangyfelach Street, for J. Strick; new offices of London and North-Western Railway Co. to be lit by electricity; E.L. installation at the Market for the T.C.; additions to the Cambria Cold Storage and Ice Factory, the secretary; conversion of premises into banks at 236, High Street, and Coleridge House, Wind Street, for the Metropolitan Bank (of England and Wales), Ltd.

TAUNTON.—Two shops in Station Road (main laid). E. G. Coles, builder, Taunton.

Schools at Wilton (electric main near by). Mr. Hartnell, builder, Park Street, Taunton.

THOLTHORPE (Yorks.).—Alterations and additions to the Council school for the North Riding Education Committee. J. C. Wrigley, secretary, County Hall, Northallerton.

THORNHILL (Yorks.).—Shops and houses, Slaithwaite Road, for G. & J. Hodgson.

TONBRIDGE.—Stables for the U.D.C. K. C. Jarvis, builder, 21, Baltic Road, Tonbridge.

TONMAWR (Glam.).—Welsh Calvinistic Methodist Church.

TREGARON.—New chapel, to seat 500, at Borth. Architect, J. Arthur Jones, Aberystwyth.

TUNBRIDGE WELLS.—Shops, Vale Road, for G. Langridge; houses, Culverden Avenue, for Mrs. A. E. Wells, Mr. Manktelow, Mrs. W. Goodwin, W. J. Hales and C. Goodwin; shops, Grove Hill Road, for W. Langridge; Hopwood Gardens, for F. T. Baker.

ULCEBY (Lincs.).—New Wesleyan Church. W. Hugill Dinsley, architect, Chorley (Lancs.).

ULVERSTON.—Mansion at Fell Foot, Newby Bridge, near Lakeside, for Oswald W. E. Hedley. G. T. Wilson, architect, The Bungalow, Fell Foot, Newby Bridge, Ulverston.

UMBERLEIGH (Devon).—Farmhouse at Stowford Lodge for H. A. Landray Ellis, Son and Bowden, architects, Bedford Chambers, Exeter.

WELLINGTON (Somerset).—Additions to Cottage Hospital. E. Lee Michell, hon. sec.

WEST BROMWICH.—Electric power installations at the works for Akrill and Co., iron founders, and Brockhouse, Ltd.

WHITBY.—Enlargement of the Chapel of St. Mary, Sandsend. E. H. Smales, architect, 5, Flowergate, Whitby.

WIGAN.—Proposed Men's Institute for All Saint's Parish. Rev. Canon Matthew, rector of Wigan.

WINDSOR.—Secondary School. Architect, Education Committee, Berks. County Council.

WOMBWELL.—House and shop for A. W. Lewis. A. B. Linford, architect, Carlton Villa, Wombwell.

WORKINGTON.—Thirteen houses and shops in Murray Road (new thoro u. fare).

WORSLEY (near Manchester).—Alterations at Grove Farm, Boothstown, for Lord Ellesmere; two houses, Lampton Road, and two houses, Lumber Lane, for James Morris; four houses, Leigh Road, for William Hulme.

WREXHAM.—Public Hall, recently destroyed by fire, to be rebuilt.

YARMOUTH.—Bakery for the Co-operative Society. A. S. Newitt, architect, Regent Street, Great Yarmouth.

FORTHCOMING EVENTS.

To-day's Events (Friday, May 15th).—At the Institution of Civil Engineers. Iron and Steel Institute. Annual meeting.

Saturday, May 16th.—At 3 p.m. Liverpool and District Electrical Association. Visit to Bootle Cold Stores, Bootle.

At 7 p.m. At the Colonnade Hotel, Birmingham. Birmingham and District Electric Club. Paper on "Electrical Porcelain," by Mr. H. W. Brady.

Tuesday, May 19th.—At 3 p.m. Royal Institution. Lecture on "What is it which Vibrates?" by Prof. F. T. Trouton.

Thursday, May 21st.—At 8 p.m. At the Royal Society of Arts. Institution of Electrical Engineers. Paper on "Recent Progress in Tungsten Metallic-Filament Lamps," by Mr. H. Hirst.

Friday, May 22nd.—At 5 p.m. At the Royal College of Science, South Kensington. Physical Society. Paper on "The Production of Small Alternating Currents of Variable Frequency Suitable for Telephonic and other Measurements," by Mr. B. S. Cohen. Council meeting at 4.30 p.m.

Saturday, May 23rd.—Junior Institution of Engineers. Visit to Avonmouth Docks works and electricity works, Bristol.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

The following orders are issued:—

Monday, May 18th.—"A" Company. Infantry drill, 6 p.m.
Tuesday, May 19th.—"B" Company. Infantry drill, 6 p.m.
Thursday, May 21st.—"C" Company. Infantry drill, 7 p.m.
Friday, May 22nd.—"D" Company. Infantry drill, 7.15 p.m.
Tuesday, May 19th.—Medical inspection for recruits, 6 p.m.

Men who have not signed on in the Territorial Force can do so on their Company night.

J. H. S. Phillips, Capt.,
Acting Adjutant.

NOTES.

Electricity at the Pit Mouth.—An interesting example of electrical enterprise on a large scale in connection with a coal mining undertaking in Germany is afforded by the Hibernia Co., which is one of the most extensive concerns of this kind in that country. It is mentioned, in the course of the directors' report for 1907, that the extension of the power stations was continued during the year both for the company's own consumption, and for supply to the Westphalia Electricity Works, and the work will be brought to a certain conclusion, although not a final one, in the middle of this year. The power stations will then have a capacity of 20,000 H.P., whereas no electrical installations were owned by the company in 1902. All the pits and air shafts, with the exception of the Altstaden pit, which is situated too far from the main generating stations, are connected together by means of duplicate cables. By this means an extraordinary economy in reserve plant is claimed to have been obtained; an interchange of current, which can be produced at any time where it can be most economically generated, has been effected, and the company is able to let the pits which have no coking ovens participate in the advantages of the surplus gases. Hitherto the undertaking has laid 75 miles of cables and aerial conductors, whilst 80 miles of cable network of the Westphalia Electricity Works are connected with the system. In 1904 the enterprise was the first in the Ruhr to lay down an experimental installation of 450 H.P. at the Hibernia Colliery to utilise exhaust steam turbines, and as this proved to be very advantageous a 2,400-H.P. exhaust turbine was installed and started at Shamrock I-II in April, 1907, and has fully answered expectations. On the bringing into operation of the new installations at Shamrock-Behrens shafts, and at Schlägal and Eisen III-IV, there will be five central power stations at work with nine live steam turbines, two exhaust steam turbines, and one gas engine. The total production of the company's plant in 1907 amounted to 23,500,000 KW.-hours, as compared with 13,900,000 KW.-hours in 1906, and 5,085,536 KW.-hours of the former total were sold to other undertakings, the balance being consumed by the producers. The supply afforded to the Westphalia Electricity Works was first commenced in December, 1906, and the company has erected two receiving stations at Shamrock I-II and at Shamrock-Behrens pits; it absorbed 4,900,000 KW.-hours in 1907, out of the total quantity sold.

Stolen Cable.—Harry Vivian, electrician, and John Aspinall, an assistant, both in the employ of the British Westinghouse Company, Manchester, were charged at Lancaster Castle on May 2nd with stealing 90 lb. weight of scrap cable, &c., at Heysham Harbour Station on April 30th. Mr. Albert de Neiderhausen, engineer for the British Westinghouse Co., of North View, Temperley, at present in charge of a contract in connection with the new electrical railway between Morecambe and Heysham and Lancaster, said the men were both employed by the company. He last saw the scrap cable, &c., on the siding at Heysham Harbour, and did not miss it until the police drew his attention to it. Prisoners had no right to take the things without asking him. They did not receive permission to take either the cable or the wire. In reply to the Bench, he said the men were not allowed to take scrap in large quantities, but when it would not pay railway fare to return the scrap to the works, the men were allowed to sell it, by his permission. The money was divided amongst the men. Vivian had worked for him two years on the Metropolitan Railway, and also on a Derby contract; he was a respectable man. He also knew Aspinall's parents and family. He had never decided to sell the scrap at Heysham locally. Prisoners both pleaded guilty and expressed regret, and the Bench imposed a penalty of 10s. costs or 14 days.

Electrical Contractors' Association (Inc.) Leicester.—This local branch of the Association held its first annual meeting at the Grand Hotel, Leicester, on Tuesday, 5th inst. The honorary officers and committee were unanimously re-elected, and the financial statement for the year ending April 30th, 1908, showed that the treasurer had a balance in hand of £22 14s. After the annual meeting the whole of the members sat down to dinner together. Among those present may be named:—Mr. S. H. Webb, chairman; Mr. C. Squire, honorary solicitor; and Mr. J. Orringe, honorary secretary and treasurer. The honorary secretary of the Association, Mr. L. G. Tate, was also present.

The B.A. at Dublin, 1908.—The annual meeting of the British Association is to be held at Dublin, from Wednesday, September 2nd to 9th, with Mr. Francis Darwin, F.R.S., &c., as president. Section A (Mathematical and Physical Science) will be under the chairmanship of Mr. W. N. Shaw, M.A., D.Sc., F.R.S. The Economic, Science and Statistical Section (F) will be presided over by Mr. W. M. Acworth; the Engineering Section (G) by Mr. Dugald Clerk, who contributed so largely to the success of last year's meetings of the Section; and in the Educational Science Section (L) Prof. L. C. Miall will preside. Members proposing to contribute to the Sectional Transactions should apply to the assistant secretary of the Association at Burlington House. Dublin was last visited by the Association in 1878, prior to which there were two visits to the city (1835 and 1857). It is pointed out by the local secretaries that in the week previous to the meetings, the Dublin Horse Show takes place, for which occasion hotel and other such charges are raised. This a point for visitors to remember when booking their accommodation for the B.A.

Midland Corps of Electrical Engineers.—We learn that the movement in connection with the electrical engineers required for the Territorial Army is making considerable progress in Birmingham. As explained in a previous issue, three companies are being raised in Birmingham by Mr. J. F. Lister, who will be in command with the rank of lieutenant-colonel; they are to be known as the Southern Wireless Company, the Southern Cable Company, and the Southern Airline Company.

The Wireless Company will be commanded by a captain, and the Cable and Airline Companies each by a major. These officers will be responsible for their own companies on mobilisation. The companies will be what are known as "Army Troops," and on mobilisation they may not necessarily be attached to the Birmingham Regimental District.

The period of annual training is from 8 to 15 days, the August Bank Holiday week being included. The place of training has not yet been fixed, but in all probability it will be Salisbury Plain.

We hear that about 150 men have already been attested, and no difficulty is anticipated in raising the required number, namely, 500. Several well-known members of the Local Section of the Institution of Electrical Engineers have been offered, and have accepted commissions in this new unit.

Accident to a 10,000-H.P. Alternator at Niagara.—Mr. Orrin E. Dunlap, Niagara Falls, N.Y., writes:—"While undergoing the builders' test in station No. 3 of the Niagara Falls Hydraulic Power and Manufacturing Co. about 9.30 o'clock on the evening of Tuesday, April 28th, a 10,000-H.P. alternator built by the Allis-Chalmers Co., of Milwaukee, flew to pieces. The weight of the machine was about 125 tons, and its value was about $40,000. The rotor weighed about 50 tons. Its normal speed was rated at 300 R.P.M. When it burst it was making about 460 revolutions, the effort being to speed the machine up to 506 revolutions, which was the runaway speed of the water-wheel which operated it. The machine had been successfully tested in every other way, and had exceeded all guarantees. The actual tests in the laboratory of the material that entered into the alternator show that it had been subject to over four times the strain that was due to the speed. The accident was due to a failure of the steel rotor, three of the pole-pieces breaking from their fastenings and flying about. Stanley Matthews, representing the builders, stood near the mechanism for the water-wheel regulation. When the accident occurred he fell, and was bruised and injured, but not seriously. George R. Shepard, B. F. Lee, and another employé of the Niagara Falls Hydraulic Power and Manufacturing Co. were engaged in holding a tachometer on the end of the shaft. Mr. Lee, the electrical superintendent, was the worst injured of the three, having been bruised in many places. The damage to the other machinery in the station, as well as to the power house, was of a minor nature. The Niagara Falls Hydraulic Power and Manufacturing Co. has had other machines of similar design, but not so large, in use for five years, and has had no trouble with them. The conditions met in the design are nowhere near so rigorous as those met in connection with steam turbines, of which the designer has built many. The Niagara Falls Hydraulic Power and Manufacturing Co. has full faith and confidence in the designer, and the Allis-Chalmers Co. will replace the alternator as quickly as possible, having also received an order for the second machine since the accident."

Electricity and Theft Detection.—The other evening two engineers employed in the Etna Iron Works, near Wishaw, noticed electric flashes proceeding from the Clyde Valley Electrical Co.'s exposed cable between the Etna works and those of the Stirling Boiler Co. They found two men cutting down a telephone wire, one end of which had fallen on the Clyde Valley Co.'s wire, causing the flashes seen by the engineers. Information was given to the police, with the result that the two men—both telephone linesmen—were convicted of the theft of 20 lb. of bronze wire from twelve telephone poles, and sent to prison for 60 days each.

Institution Notes and Lectures.—Institution of Electrical Engineers (Glasgow Local Section).—The annual report of the Committee was submitted to the general meeting of the Section on the 12th inst. The Committee remarks that the number of papers submitted by members of the Section has been unusually small, and urges them to recognise the obligations incurred by membership. The number of members has increased steadily and now amounts to 294. For the Session 1908-9 the full Committee is constituted as follows:—Chairman, W. W. Lackie; Past Chairmen, John M. M. Munro and Prof. Francis G. Baily; Vice-Chairman, Sam. Mavor; Chairman of Students' Section, Prof. Magnus Maclean; Hon. Sec. and Treasurer, James E. Sayers; Members, Chas. Day, Frank Newington, J. S. Nicholson, J. K. Stothert, Wm. M'Whirter, Joseph Taylor, Robert Robertson, E. George Tidd, J. Robertson. The Committee refers with feeling to the loss which the Section has suffered, in common with the Institution and with the whole scientific and engineering world, through the death of Lord Kelvin, the first chairman of the Section, and concludes with a tribute to the valued services of Mr. James E. Sayers as hon. secretary.

The Glasgow Students' Section also reports a dearth of papers from its own members. The number of students in the Section has increased to 85. The Committee for session 1908-9 consists of Prof. Magnus Maclean, M.A., D.Sc., chairman; Messrs. John S. Nicholson, B.Sc., and R. B. Mitchell, vice-chairmen; Mr. James W. Campbell, B.Sc., hon. sec.; and Messrs. M'Minn, Jeffrey Orchard, Bottomley, Thomson, Downie and Miller.

Institution of Electrical Engineers (Birmingham Local Section).—At the annual general meeting on May 6th, Prof. Kapp, in moving the adoption of the Committee's report, briefly reviewed the work of the session. He said that the new scheme of dealing with the Institution papers was working very satisfactorily, the chief advantages being that any Section short of papers was able to take papers by members of other Sections for reading and discussion, and also there was the advantage that Local Section papers could be selected for reading in London. Unfortunately, owing to the sad death of the President of the Institution, they had had to postpone the annual dinner of the Birmingham Local Section. It was hoped, however, that this function would be held next session, some time in November. There was a gratifying increase in the attendance at their meetings, the average being 40 per cent. greater than the average of last session; also, their total membership had increased by 14 per cent. There was a proposal to include in the Birmingham Local Section the districts of Derby, Leicester and Nottingham; he hoped that this matter would be arranged, as it would be advantageous to electrical engineers in those districts and to the Birmingham Local Section.

Prof. Kapp then made an appeal to members in connection with the corps of Electrical Engineers now being raised in Birmingham in connection with the Territorial Army. The Institution of Electrical Engineers had taken this matter up, and he hoped that many members of the Local Section would offer their services in connection with the Birmingham companies.

Institution of Electrical Engineers (Dublin Section).—Yesterday the annual general meeting of this Section was held; and a paper was read by Mr. R. N. Tweedy on "The Tangential System of Suspending Overhead Trolley and Transmission Wires."

Junior Institution of Engineers.—A paper on "The Purification of Water" was read at a recent meeting, by Mr. Geo. H. Hughes, M.I.Mech.E., of Walton-on-the-Naze. On the subject of sterilisation, the author recounted his experience in successfully applying copper sulphate in the treatment of a South African water, which occasionally developed algae. Such growth often occurred where circulation was imperfect, and the Staines reservoir was instanced as an example, but with the aid of copper sulphate the oscillaria had been dispersed. He considered an electrolytic hypochlorite solution to be the best remedy in such cases.

Will.—According to the *Times*, Sir Auckland Colvin (of the Oriental Telephone Co., Ltd.), left £27,030 gross, with net personalty £24,411.

Appointments Vacant.—Evening class teacher in electrical engineering for the Great Eastern Railway Institute, Stratford.

Fatality.—On the 8th inst. a labourer named Arnold Carr, of Middlesbrough, employed in the ironworks of Sir Bernard Samuelson & Co., of that town, where electrical plant is being installed, was found dead in front of a live switch panel, adjoining a dead panel on which he had been working.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—In consequence of the resignation of the chief assistant engineer (Mr. G. Thompson) of the Swansea electricity department, to take up the appointment of electrical engineer to the Neath Rural District Council, a rearrangement of the staff has taken place, whereby Mr. A. Rees, the present senior in charge, and Mr. H. K. Benson, of the mains department, will undertake between them Mr. Thompson's work in addition to their own, their remuneration in consideration of this extra work being increased to £2 10s. per week.

The staff of the York electricity works on Saturday presented a case of fish knives and forks to Mr. E. J. Walsh, a member of the staff, on his marriage.

West Ham Electric Lighting and Tramways Committee has advanced the salary of Mr. G. Lloyd Jones, resident engineer, from £260 to £280 per annum, rising to £300 per annum at the expiration of twelve months, and the salary of Mr. W. McKenzie, station foreman, from £3 10s. to £3 15s. per week.

Bailie Arch. Campbell and Councillor Finlay have been recommended by the Glasgow T.C. Electricity Committee as the deputation, along with the engineer, to attend the annual convention of the Incorporated Municipal Electrical Association.

The Watford U.D.C. has received no fewer than 210 applications for the post of electrical engineer. Before the final selection is made, the Electric Lighting Committee is to visit some six electric lighting undertakings where some of the candidates are engaged, in order to see the actual nature of their work, and to obtain other information.

On the occasion of his marriage, which took place at Merton Parish Church on April 25th, Mr. Reginald W. Klitz, mains engineer to the Wimbledon Borough Council, was presented with an oak case containing 80 pieces of table plate, by the officials of the Corporation, and a spirit tantalus by the employés in the mains and street lighting departments.

On 6th inst. a smoking concert was held in the Royal Restaurant, Glasgow, by the staff and employés of the Clyde Valley Electrical Power Co., when a presentation was made to Mr. James L. Graham on his leaving the company to take up a position in Italy, with the British Westinghouse Co. For the past three years Mr. Graham has been station superintendent at the company's Yoker Works, and is well known in Glasgow engineering circles, having been with Messrs. Dansmuir & Jackson and the Glasgow Corporation tramways department for a considerable number of years. The presentation consisted of a portable aneroid barometer from the Yoker staff, and a slide rule and case of drawing instruments from members of the other departments. Mr. D. A. Starr, the general manager of the company, made the presentation.

Mr. J. Rogers, of Portsmouth, has obtained an appointment under the Government of Malta as assistant engineer at the electric lighting works.

Tramway Officials.—The Glasgow T.C., by the casting vote of the Lord Provost, has decided to increase the salary of Mr. James Dalrymple, the manager of the Corporation tramways from £1,000 to £1,100. The proposal to increase the salary of Mr. Goslin, electrical engineer, from £475 to £550, was carried, but proposed advances of £25 each to Mr. MacKinnon, traffic superintendent (present salary, £575) and to Mr. Ferguson, chief engineer (present salary, £575) were defeated on a vote.

Mr. E. Banner has been appointed clerk of the works for the extension of the Burton Road electric route of the Derby Corporation Tramways.

General.—Mr. Wm. T. Hoal has been appointed Postmaster-General of the Cape of Good Hope.

Mr. Edward H. Fleming, who has during the past 6½ years, held the position of rolling stock superintendent of the Newcastle-on-Tyne Corporation tramways, has resigned his position, and has been appointed London manager of the "Empire" Lubricating Co., Ltd., of Liverpool. His metropolitan address is Salisbury House, London Wall, E.C.

Mr. J. B. Lambie has been appointed London manager and engineer to the Walsall Electrical Co., Ltd., in succession to Mr. Chas. Lill, who has been appointed sales engineer to the Hackney Borough Council. Mr. Lambie wants manufacturers to send him their lists with discounts.

Obituary.—Intelligence has reached Spennymoor (Co. Durham) of the death at New York of Mr. Manthorpe, who was for over seven years manager at Spennymoor for the Northern Counties Electric Supply Co. Mr. Manthorpe only recently left Spennymoor to take up a position with Lloyd's Shipping Co.

NEW COMPANIES REGISTERED.

Greystones Electric Light and Power Co., Ltd. (3,311).—This company was registered in Dublin on May 8th, with a capital of £3,500 in £1 shares, to carry on the business of electrical engineers, electricians, practical engineers, contractors, &c. The subscribers (each with one share) are:—C. L. Matheson, K.C., 20, Fitzwilliam Square, Dublin; A. Macaulay Fitzgibbon, The Bungalow, Greystones, Co. Wicklow, barrister; A. M. Archer, M.D., J.P., Bellevue, Delgany; A. L. Figgis, Grove Hill, Greystones, Co. Wicklow, grain merchant; F. Batchelor, The Gables, Greystones, Co. Wicklow, architect; E. S. Dashwood, Green Edge, Carrickfergus, electrical engineer; R. N. Tweedy, 5, Leinster Street, Dublin, electrical engineer. The number of directors is not to be less than three or more than seven; the first are C. L. Matheson, H. M. Fitzgibbon, A. L. Figgis, F. Batchelor, A. M. Archer, E. S. Dashwood and R. N. Tweedy; qualification, 100 shares; remuneration as fixed by the company. Registered office, 5, Leinster Street, Dublin.

Richard Pape, Ltd. (97,901).—This company was registered on May 8th, with a capital of £10,000 in £1 shares, to acquire the benefit of a contract relating to an electric storage battery known as the "Fors Accumulator," together with the business of manufacturing and selling the same carried on at 110, Strand, W.C., and Dyott Street, Oxford Street, W., to adopt an agreement with R. Pape, and to carry on the business of electrical engineers, manufacturers of and dealers in accumulators, storage batteries and electrical appliances of all kinds, &c. The subscribers (with one share each) are:—F. J. Wood, 24, Valentine's Road, Ilford, secretary; R. Pape, 25, Manor Road, Beckenham, electrical engineer; W. Simpson, 77A, Ormiston Road, W., accountant; Miss E. M. Smith, 45, Wightman Road, Harringay, N.; F. Pape, 17, Montrave Road, Penge, electrical engineer; T. E. Ind, 98, Haggerston Road, N.E., clerk; G. W. Watson, 14, Gerda Road, New Eltham, Kent, managing clerk. No initial public issue. Table "A" mainly applies.

Unity Motor, Electrical and General Engineering Co., Ltd. (97,911).—This company was registered on May 9th, with a capital of £1,000 in £1 shares, to carry on the business of garage proprietors, motor, electrical and general engineers, machinists, fitters, tin and coppersmiths, &c., to acquire the business of the Unity Motor, Electrical and General Engineering Works, Orchard Street, Bristol, and to adopt an agreement with A. A. Taylor. The subscribers (with one share each) are:—T. H. Gore, 52, Queen Square, Bristol, shipowner; W. Jenkins, 52, Queen Square, Bristol, clerk; A. A. Taylor, Orchard Street, Bristol, consulting engineer; A. G. Hill, 52, Queen Square, Bristol, accountant; L. A. D. Taylor, Orchard Street, Bristol, engineer; F. Cottle, 11, Richmond Terrace, Bedminster, Bristol, accountant; R. M. Webb, 17, Islington Road, Southville, Bristol, clerk. No initial public issue. Table "A" mainly applies; the first directors are T. H. Gore, A. A. Taylor, A. D. Matthews and W. Jenkins. Registered office, 52, Queen Street, Bristol.

Electric Control, Ltd. (6,805).—This company was registered in Edinburgh on April 30th, with a capital of £6,000 in £1 shares, to carry on the business of electrical and mechanical engineers, and manufacturers of and dealers in appliances and apparatus for the generation, supply and control of electrical power, including electric motors and brakes, &c. The subscribers (with one share each) are:—J. R. S. Maxwell, Baillieston House, Baillieston, Glasgow, electrical engineer; C. Macmillan, Cromlech Clynder, Dumbartonshire, electrical engineer; J. Craig, Netherlea, Partick, engineer; Mrs. R. Scott, Baillieston House, Baillieston; Miss L. Scott, Baillieston House, Baillieston; Miss R. M. Scott, Baillieston House, Baillieston; H. M. Macmillan, Cromlech Clynder, Dumbartonshire, retired shipowner. The number of directors is not to be less than two or more than six; the first are J. M. S. Maxwell, C. Macmillan and J. Craig; qualification, 100 shares; remuneration as fixed by the company. Registered office, 177, Reid Street, Bridgeton, Glasgow.

Tewkesbury Electric Light Co., Ltd. (97,848).—This company was registered on May 4th, with a capital of £5,000 in £1 shares (2,000 preference), to acquire the interest of J. Parker under the Tewkesbury Electric Lighting Order, 1905, to adopt an agreement between the Town Council of Tewkesbury and J. Parker, and a provisional contract between the same parties, whereby the company will acquire a lease of a site for the generating station, and to carry on the business of an electric light and power company in all its branches. The subscribers are:—J. Mitchell, Bryntirion, Hereford, tailor and draper, 100 shares; A. Johnson, The Highlands, Brooney Hill, Hereford, civil engineer, 100 shares; J. Parker, 14, Nelson Street, Hereford, surveyor, 200 shares; T. W. Meats, 89, Broad Street, Hereford, chartered accountant, 25 shares; C. W. Jones, Oldbury Road, Tewkesbury, engineer, 25 shares; J. H. Edwards, 2, Fernbank Road, Bristol, electrical engineer, 150 ordinary and 150 preference shares; A. L. Stephens, Tyrwhitt, Downs Park East, Bristol, electrical engineer, 100 ordinary and 100 preference. Minimum cash subscription, £1,000. The number of directors is not to be less than three or more than five; the first are J. Mitchell, A. Johnson, J. Parker, and J. H. Edwards; qualification, £100; remuneration as fixed by the company. Registered by Clarkson, Greenwell & Co., 10-11, Lime Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lamp Manufacturing Co., Ltd. (London), (76,151).—Issue on April 15th of £150 5 per cent. debentures, part of series created February 18th, 1903, to secure £2,500, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £2,350.

Bradford Electrical Engineering Co., Ltd. (95,462).—This company's annual return was filed on March 7th, when 1,182 shares had been taken up out of a nominal capital of £3,000 in £1 shares. £1 per share has been called up on 732, resulting in the receipt of £482. £250 remains in arrears. £450 is considered as paid on the remainder. Mortgages and charges: Nil.

Harry W. Cox & Co., Ltd. (96,136).—This company's statutory report, dated March 9th, was filed on March 18th. 4,000 shares (class not specified) have been taken up out of a nominal capital of £5,000 in £1 shares (4,000 preferred ordinary); 1,000 shares are considered as fully paid. No mortgages or charges registered. Registered office, 47, Gray's Inn Road, W.C.

Waterworks Lighting and Power Investment Corporation, Ltd. (88,390).—Issue on April 7th of a £200 6 per cent. debenture, part of series created August 8th, 1905, to secure £10,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £8,055.

St. Austell and District Electric Lighting and Power Co., Ltd. (66,882).—Issue on April 10th of £200 5 per cent. debentures, part of series created June 1st, 1904, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £1,800.

Cambridge Electric Tramways Syndicate, Ltd. (79,744).—This company's annual return was filed on March 5th, when 107 shares had been taken up out of a nominal capital of £5,000 in £10 shares. £3 0s. 4½d. per share has been called up on 90, £10 per share on 10, and nil on seven shares, resulting in the receipt of £911 12s. 1d. Mortgages and charges: Nil.

W. E. Dove & Co., Ltd. (72,630).—This company's annual return was filed on March 21st, when the entire capital of £2,500 in £10 shares had been taken up. £1,300 has been paid on 180, and £1,200 is considered as paid on 120 shares. Mortgages and charges: £1,000.

Birmingham Electrical Case Co., Ltd. (93,998).—A mortgage dated April 10th, 1908, and, as collateral security thereto, a debenture of even date, to secure £60, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holders: F. E. Bell, 6, Cherry Street, Birmingham, and P. T. Thompson, 21, Salisbury Road, Handsworth.

Marten & Jellicoe, Ltd. (Electrical and general engineers, Thames Ditton), (94,313).—Issue on April 27th of £500 5 per cent. debentures, part of series created September 18th, 1907, to secure £10,000, charged on the company's property, present and future, including uncalled capital. No trustees. Previously issued of same series: £3,900.

South Metropolitan Electric Light and Power Co., Ltd. (47,875).—Issue on April 14th of a £10,000 4½ per cent. debenture, part of series created by resolutions of July 3rd, 1900, and May 6th, 1904, to secure not more than the amount of the capital for the time being issued and paid up. Property charged: The company's undertaking and property, present and future, including uncalled capital (if any). Trustees: H. R. Beeton, 18, Austin Friars, E.C., and W. R. Davis, 10, Moorgate Street, E.C. Previously issued of same series: £255,968.

RECENT EXTENSIONS OF THE MANCHESTER ELECTRICAL DEPARTMENT.

On page 776 of our last week's issue we briefly recorded, amongst other information referring to Manchester, the official starting-up of the first 6,000-kw. turbine unit installed in the Stuart Street station of the Corporation. This 6,000-kw. set is only one of a series which will have to be installed in order to keep pace with Manchester's rapidly growing demand for electrical energy. Even at the time of our last description of the Manchester stations, in June, July and September, 1903, there was ample evidence of the enormous development which was pending. The scheme, as shown by the drawings of the Stuart Street station then published, contemplated further extensions of large reciprocating units, of which two further sets, each of 4,000 kw. capacity and similar to the two at present in use, could be accommodated in the existing No. 2 engine room. On the initiative of Mr. S. L. Pearce, however, it has been decided to substitute turbine-driven plant, of which some 30,000 kw., representing five units of 6,000 kw. capacity each, can be installed in the same space.

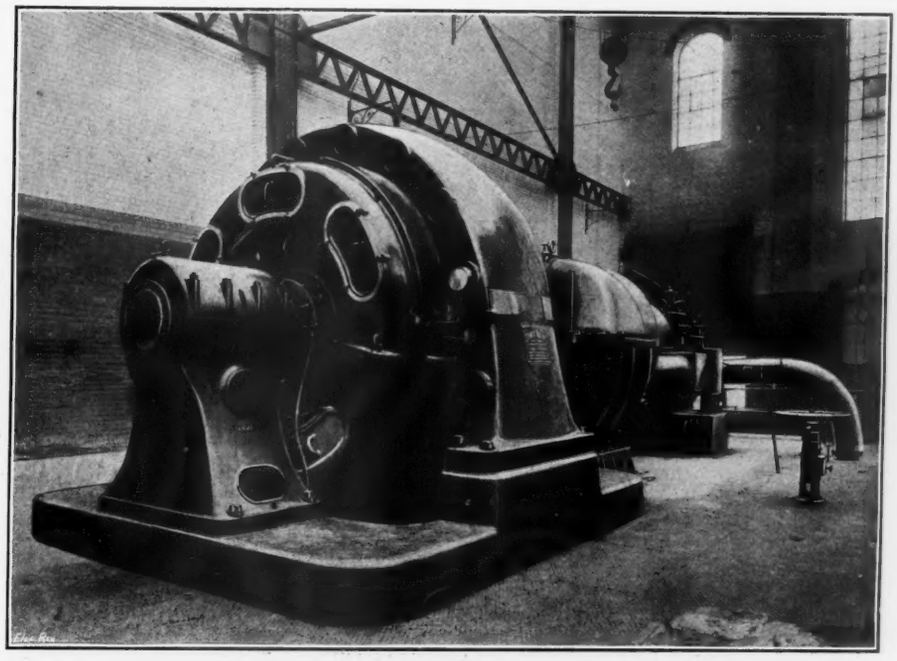


Fig. 1.—View of the 6,000-kw. Three-phase Turbo-alternator, Recently Installed at Stuart Street Generating Station, Manchester.

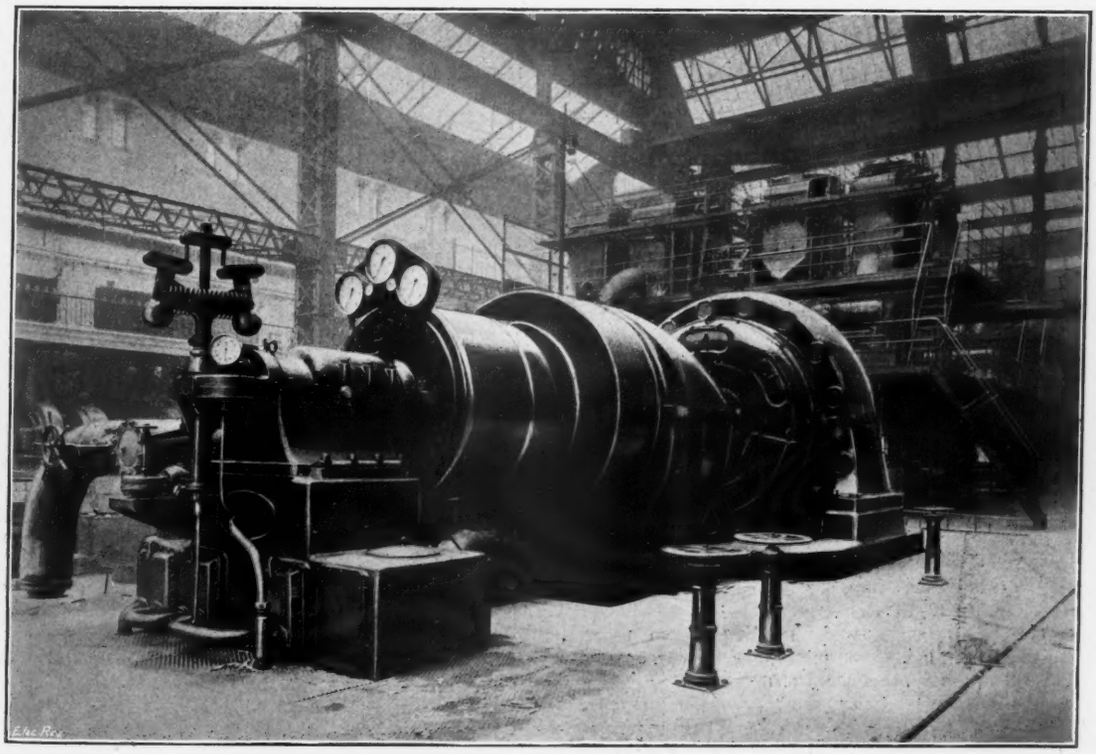


Fig. 2.—The Steam End, Willans-Siemens 6,000-kw. Turbine Unit, showing Reciprocating Plant Behind.

Of the total of 64,800 h.p. of steam plant installed in the three Manchester generating stations, the Stuart Street plant includes 37,000 h.p.; of this 15,000 h.p. forms the complete equipment of the No. 1 station, and the remaining 22,000 h.p. is installed in the No. 2 station, which alone has space available for steam plant extensions.

The maximum load at Stuart Street in December last

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reached 15,000 KW., and is estimated to increase at the rate of 5,000 KW. a year for the next two years; hence the necessity of installing another 6,000-KW. turbine unit this year and of providing for still another set of the same size to be installed in 1909-10, as mentioned in our last week's issue.

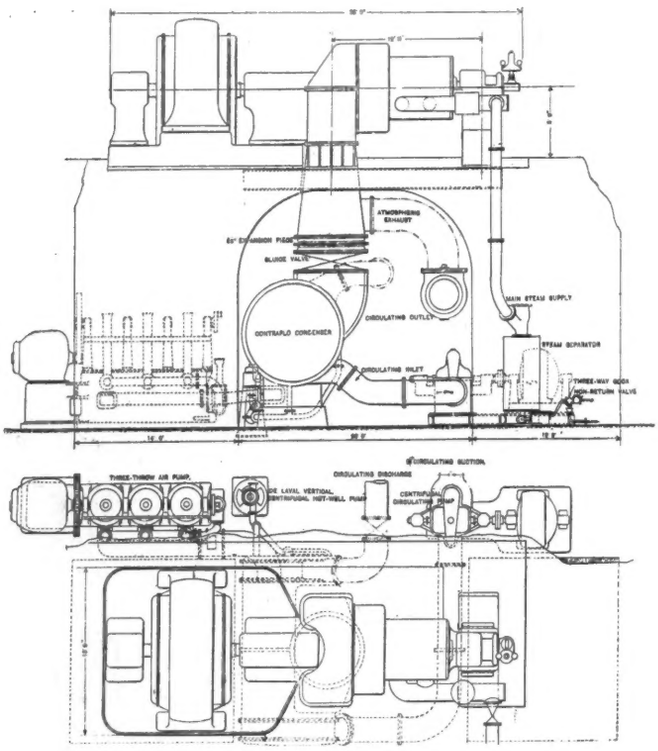


FIG. 3.—SHOWING THE LEADING DIMENSIONS AND ARRANGEMENT OF THE 6,000-KW. TURBINE UNIT.

The first turbo-alternator unit, of which figs. 1 and 2 are views from the steam and electrical ends, consists of a 10,000-H.P. Willans turbine coupled to a Siemens three-phase alternator running at 1,000 R.P.M.

The guaranteed steam consumption is 15·85 lb. per KW.-hour at full load, corresponding to 10·75 lb. per I.H.P.-hour, the steam being at 190 lb. pressure, superheated 100-120° F.

The overall length of the complete plant is 46 ft. 3 in., of which 36 ft. is the length of the turbine and generator, and the diameters of the H., I. and L.P. portions of the rotor are 34, 51 and 77½ in. respectively.

As will be seen from the drawing, fig. 3, the turbine exhausts into a condenser situated immediately underneath, the latter being of the Contraflo type, supplied together with the circulating and air pumps by Messrs. Richardsons, Westgarth & Co.

The condenser has a cooling surface of 10,500 sq. ft., and is specified to maintain a 27-in. vacuum.

The air pumps are of the three-throw Edwards type, gear driven from a 25-B.H.P. enclosed motor, and a force pump, consisting of a 12-H.P. motor with vertical spindle operating a De Laval centrifugal pump, is provided to lift the hot-well discharge into the feed tanks.

The circulating pump is of the Worthington pattern, coupled to a 250-H.P. enclosed motor, and having a capacity of 7,700 gals. per min. at a speed of 600 R.P.M.

Both the above-mentioned motors operate on direct current at 420 volts, and together with the control panels were supplied by Messrs. Siemens. The control panels are generally similar, being each fitted with a circuit-breaker, ammeter, and series of knife control switches for regulating the amount of starting resistance—the resistance grids, of cast-iron, being fixed below the switch panels.

The exhaust casing below the turbine is 66 in. in diameter, and is provided with a motor-driven sluice valve for shutting off the condenser if desired, when the alternative atmospheric discharge would be utilised.

The alternator is a totally enclosed machine, having a normal full-load output of 7,060 K.V.A. or 6,000 KW. with a power-factor of ·85; it supplies current at a pressure of 6,500 volts between phases, and a frequency of 50 cycles per second, when running at 1,000 R.P.M., and is capable of dealing with overloads of 15 per cent. continuously, 25 per cent. for 1½ to 2 hours, and 50 per cent. for ¼ hour, the temperature rise at normal load not exceeding 45° C.

The alternator is of the salient-pole type, there being six double poles of round section, each of which is a separate casting. The field windings are of flat copper insulated with press-spahn. Excitation current at 200 to 225 volts is obtained from the station direct-current bus-bars.

The stator of the machine is of the open-slot type with former-wound coils, there being four slots per pole per phase.

The efficiency of the machine, including windage, is as follows :—

7,500 KW.	with	cos. ϕ	=	·85	... 95·9 %
6,250	,,	,,	=	·85	... 95·2 %
5,000	,,	,,	=	·85	... 94·9 %
2,500	,,	,,	=	·85	... 90·9 %
1,250	,,	,,	=	·85	... 83·7 %

The inherent regulation of the machine is such that with full non-inductive load thrown off, the rise in pressure will not exceed 3·5 per cent., and with full inductive load thrown off it will not exceed 13·5 per cent.

Forced ventilation is provided by means of a Sirocco fan driven by a Siemens 23-B.H.P. direct-current motor; by this means some 21,000 cb. ft. of air per minute can be drawn from outside the station through a dry-air filter, and supplied through a duct to the machine, from which it is taken outside again by means of another duct.

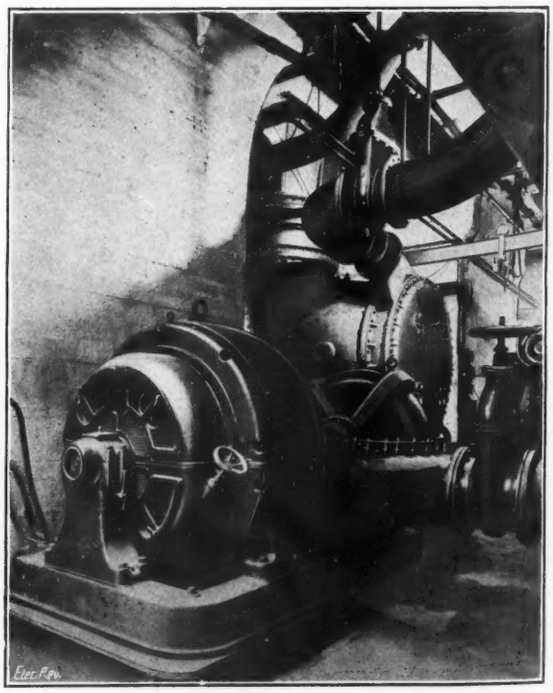


FIG. 4.—RICHARDSONS, WESTGARTH'S TURBINE CONDENSING PLANT; 250-H.P. CIRCULATING PLANT IN FOREGROUND.

The main switchboards at Stuart Street are of Messrs. Ferranti's design, arranged on three galleries on one side of the engine room.

The existing main switchboard, situated on the middle gallery, controls the two 4,000-KW. units (described by us in September, 1903), 14 H.T. feeders and two 200-KW. exciting sets. The main lighting and traction bus-bars run along the upper gallery, and the bottom platform contains the main oil switches.

Further along on the middle platform are the auxiliary lighting and power boards, each controlling 20 circuits and fed from the existing direct-current plant, or through the sub-station plant at Stuart Street, which occupies a railed-off strip in front of the switch galleries. The sub-station plant consists of four 300-KW. synchronous motor-generators, a 100-KW. induction motor-balancer and one 500-KW. motor-converter, and the controlling switchgear faces it on the lower gallery.

The new turbine unit has necessitated a further extension of the switchgear, which also has been carried out by Messrs. Ferranti.

This is of the remote-control type for dealing with the output of the 6,000-KW. generator and controlling seven feeders, of 1,000 and 2,000 KW. capacity, and a group feeder-switch. The control panels are arranged in two tiers on the main gallery and operate 630-ampere generator and 750-ampere group feeder oil switches, of the Ferranti solenoid pattern, fitted in masonry cells in the basement. Behind these on the same level are the three lighting and three traction bus-bars, in horizontal compartments one over the other, with isolating switches underneath, fitted in fireproof compartments.

These bus-bars, in addition to being coupled to feeder bus-bars on the floor above (*i.e.*, the basement gallery), are connected by cable with the H.T. bars of the original switchgear on the top platform. The feeder switchgear, constructed like the foregoing on the cellular principle, and arranged on the basement gallery, includes a group feeder connection cell, four 2,000-KW., three 1,000-KW., and three spare feeder cells. The bus-bars run in horizontal compartments, one over the other, and over the feeder oil switches, with the isolating switches and current transformers in separate compartments behind.

Returning to the control board, all the panels carry maximum time-limit relays, ammeters and signal lamps, in addition to oil switch controllers; the lower generator panel also carries an indicating wattmeter, power-factor meter, reverse-current relays and integrating wattmeters.

A swinging panel fitted with synchroscopes and voltmeters is also provided, and a system of electrical speed control of the turbine is operated from this platform.

A reference to fig. 2 will show the relative proportions of the turbine unit and the large reciprocating plant of much smaller output in the background. The view also shows the generous proportions of the second Stuart Street engine bay, which, it may be interesting to mention, measures 174 ft. long and 115 ft. wide, and is spanned by two 50-ton electrical travelling cranes at a height of 55 ft. above floor level.

The steam-raising plant for this second installation consists of 12 Babcock & Wilcox boilers, each of 20,000 lb. evaporation capacity, and provided with a Green economiser. The advent of further turbines renders additional boilers necessary, and these are each to have a maximum evaporation capacity of 40,000 lb. per hour.

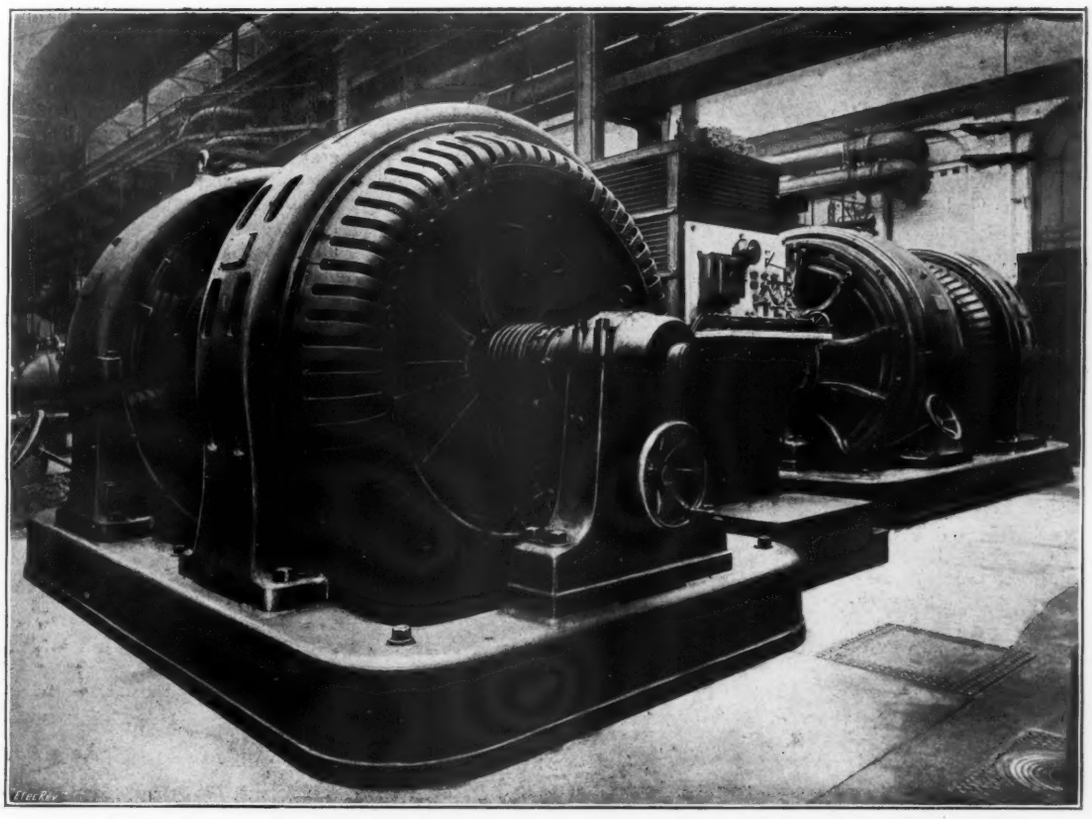


FIG. 5.—PEEBLES-LA COUR 1,500 KW. MOTOR-CONVERTERS, DICKINSON STREET STATION.

Altogether 20 Corporation sub-stations, containing 18,000 KW. of synchronous and induction motor-generator and motor-converter plant, are in use, 8,000 KW. of plant having been added since 1903.

In addition to the above, 10 sub-stations have been erected by the electricity supply department in works in the area, for the supply of energy for power purposes.

The Dickinson Street station, which has figured prominently in Manchester's electrical problems ever since the commencement of supply, has witnessed many changes of plant. In 1905 it became necessary to convert a portion of the engine room into a sub-station, to be supplied from the Stuart Street H.T. plant, and in that year three 500-KW. Peebles-La Cour motor-converters were installed. This type of plant, it is interesting to note, has since been exclusively used in the Manchester sub-stations.

In 1906 a fourth 500-KW. unit was added, and in 1907, in order further to relieve the Dickinson Street steam plant in

the winter time, and at the same time permit of its being shut down during the light summer months, three 1,500-KW. motor-converters were added.

The sub-station plant, therefore, now totals some 10,000 H.P. in Dickinson Street, in addition to the steam plant.

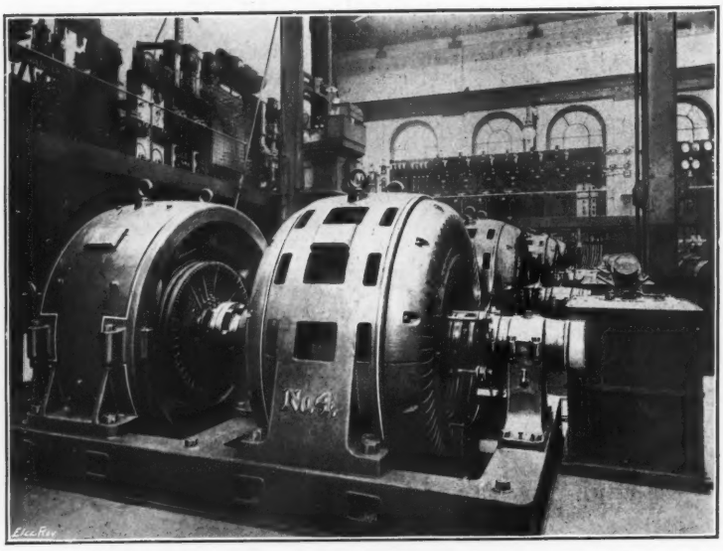


FIG. 6.—DICKINSON STREET; 500-KW. MOTOR-CONVERTER PLANT WITH SWITCHGEAR BEHIND.

The Peebles-La Cour motor-converter has been frequently described in our pages—the 1,500-KW. machines at Dickinson Street, which are shown with their switchgear in figs. 5 and 7, are the largest units of this type so far constructed, having, in fact, an overload capacity up to 25 per cent. for three hours and 50 per cent. for one hour. They are supplied on the H.T. side with three-phase current at 6,500 volts, 50 cycles, and give an output on the direct-current side of 3,300-3,500 amperes at 455-415 volts, at 300 R.P.M., being used for power and lighting purposes only. Fig. 5 gives a good idea of the proportions of these units, the starting switchgear being shown just behind. All the high and low-pressure switchgear for this sub-station plant has been supplied by the British Westinghouse Co. Our view of the gear for the large units, fig. 7, shows the eight H.T. control panels on the left, with the cells containing the oil switchgear underneath; these include two interconnector, two feeder, summation and three machine panels.

The H.T. oil switches are worked mechanically from the control board, on which all the measuring instruments are located. The H.T. bus-bars arranged behind the switch cells are in duplicate, constructed so that any machine or feeder can be plugged to either set of bars, the same plugs being available for isolating the oil switches when required.

Overload and reverse-current relays are provided on the H.T. feeder circuits, and overload time-limit relays on the A.C. machine panels.

The direct-current switchgear, on the right, consists of a series of three sets of three panels, each set being complete in itself and including an interconnector, a feeder panel for four feeders and a machine panel, reading from left to right. The panels are fitted with loose-handle circuit-breakers, opposite poles being separated by barriers.

The circuit-breakers fitted on the left-hand interconnecting panel, for coupling the large units to the station bus-bars, have a capacity of 6,000 amps. each, the other interconnector and machine breakers being of 4,000-amp. size.

The feeder switches are of the S.P. knife pattern, of 1,000-amp. size; and the D.C. machine gear is fitted with reverse-current relays.

A liquid starting switch is installed under the gallery for starting up the converters from the direct-current side.

The smaller units are designed for either lighting or traction supply at 400 or 500 volts pressure respectively, the speed being 428 R.P.M. The switchgear is generally of similar design to the foregoing, except that the direct-current feeders are grouped together; it is shown, together with the smaller 500-KW. units and the starting switches, in fig. 6.

The present area of supply is some 23 sq. miles, and the area in which powers to supply have been obtained, including Levenshulme, Droylsden, Heaton Norris, Audenshaw, Denton and Failsworth, is some 44 sq. miles.

From this it will be gathered that the problem of distribution is no small matter. Some 147 miles of streets are supplied with direct-current distribution, on the three-wire system in the outer districts and on the five-wire system in the central area, the pressure being 400 volts across the outers. The distribution network is divided up, but interconnected through fuse pillars fixed at convenient positions in the streets. Three classes of feeders are in use—the

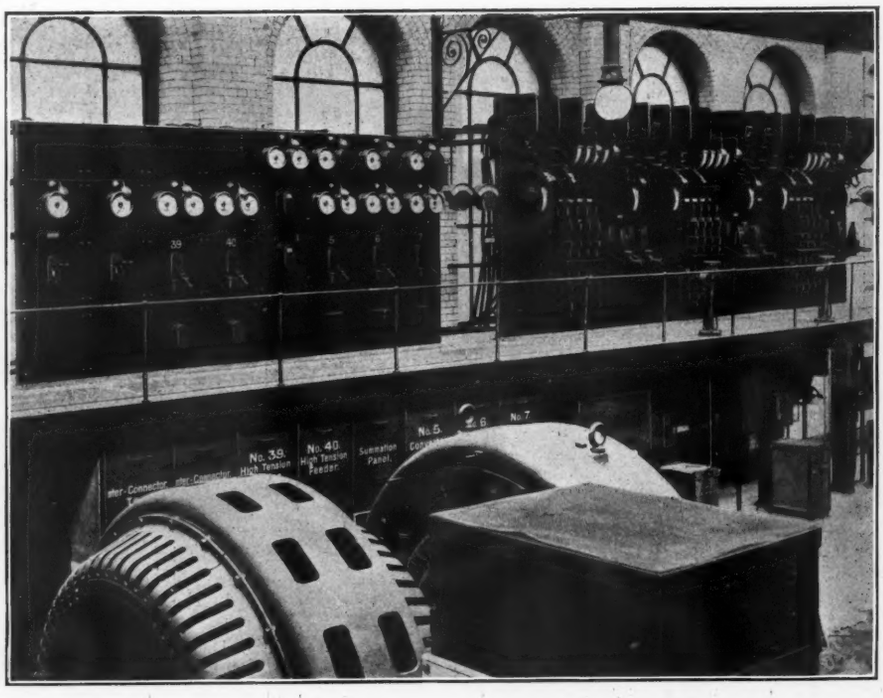


FIG. 7.—VIEW OF THE WESTINGHOUSE H.T. AND L.T. SWITCHBOARDS FOR THE 1,500-KW. MOTOR-CONVERTERS.

extra-high pressure three-phase for coupling up Stuart Street with the various sub-stations, which total 128 miles; the direct-current lighting and power feeders, amounting to 37 miles; and 26 miles of tramway feeders.

Some 200 distributor pillars, in use at important intersections of the distributing mains and between feeders and the networks they supply, are available for testing or disconnecting purposes, and altogether 338 miles of mains are in use.

The growth of electricity supply in the Manchester area can, probably, be best gathered from the statistical information published by the department, which shows that for the years ending March, 1905, 1906, 1907 and 1908, the energy sold for all purposes amounted to 33,686,710, 40,617,784, 47,564,903 and 63,317,082 units respectively, the last total being an approximate one.

For lighting and power only, the total for 1908 reaches 33,805,242 units, an increase in the year of over 11 million units.

At the present time there are actually connected, 583,751 incandescent lamps (equivalent 8 C.P.); 5,078 arc lamps (about 100 being public lamps); 3,295 motors, aggregating 24,172 H.P.—this latter total being an increase of nearly 7,000 H.P. in the 12 months. These devices total some 39,639 KW.; the maximum supply demanded last winter, however, was 28,521 KW., which figure also includes 10,288 KW. for tramway purposes. The average cost (generation, distribution and general) for the last 12 months amounted to ·84d. per unit sold, and including financial charges to 1·40d.

In conclusion, the above article illustrates the immense electrical development which is taking place in the Manchester area — an area which is industrially, probably the most important in Great Britain; incidentally the great utility of the steam turbine and motor-converter, both modern space-saving devices, is emphasised. The Manchester Electricity Department and its chief engineer, Mr. S. L. Pearce, are to be congratulated on possessing such examples of modern electrical plant as those referred to; to Mr. Pearce we are much indebted for assistance in the preparation of this article.

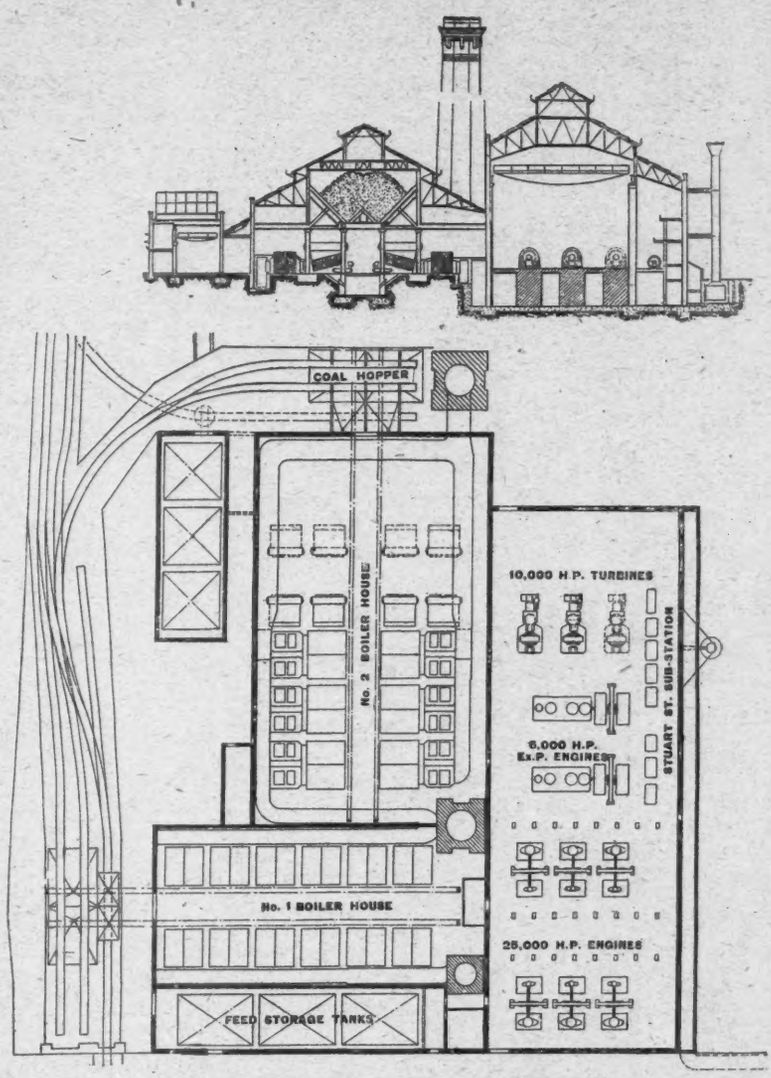


FIG. 8.—SECTIONAL VIEWS OF THE STUART STREET STATION, MANCHESTER, SHOWING THE ARRANGEMENT OF THE TURBINE PLANT.

CITY NOTES.

Callender's Cable and Construction Co., Ltd.

THE directors' report for 1907 shows a balance at the credit of profit and loss account for the year's working (after providing for income-tax) of £60,454. The balance carried forward for 1906 was £56,722, less £1,200, extra remuneration voted to the directors. The total is thus £115,976; interest on debenture stock absorbs £13,500; dividend on preference shares, £10,000; appropriation for depreciation of buildings, plant and machinery, £11,119; leaving an available balance of £81,357. A dividend on the ordinary shares at the rate of 10 per cent. per annum, clear of income-tax, being 10s. per share (whereof 5s. was paid on November 1st, 1907, and 5s. will be paid on May 30th, 1908), requires £17,500; a bonus of 5s. per share, payable on May 30th, will require £8,750; there is placed to suspense account £10,000, and carried forward, £45,107. The directors are of opinion that this result, although not so favourable as that of the previous year, must, in view of the conditions which prevailed in 1907, be considered as highly satisfactory. Various causes have rendered the operations of the company difficult and less remunerative than in previous years. The almost prohibitive price of metals and the stringency of the money market are too well known to need more than casual reference from the directors. The most pronounced factor in restricting business in heavy mains has been the abnormal price of copper which prevailed in the first eight months of last year, leading to the temporary abandonment of nearly all new enterprise in electrical supply, and to the curtailment of extensions of existing networks in every direction. This was not confined to the home trade, as diminished orders were observed in almost every area throughout the world in which the company carries on its business. The continuing downward trend of the market offered no inducement to consumers to undertake new work or to fill up their depleted cable stocks. The recent return of copper to its average price came after the season was at an end, and it may, therefore, be said that practically the whole of the company's business during the past year consisted of extensions which were absolutely necessary in connection with electrical supply stations already in existence. The subsequent stringency in the money market has delayed that improvement in business which might otherwise have been expected, and has caused difficulties in other directions, one large firm with which the company has had dealings for some years past having been forced into liquidation. Their business is in course of re-organisation, but, in order to provide against any possible loss, the directors have placed a sum of £10,000 to suspense account. Energetic measures have been taken to extend the company's connections in the Colonies and abroad. The company's business in Germany had been consolidated, and the company has been registered under German laws with its headquarters in Hamburg. Excellent results have already attended this step. In spite of the continued depression in every branch of engineering, the factories both at Erith and at Leigh are fairly well employed. The appliances at the factory at Erith and at the Anchor Works at Leigh have been thoroughly overhauled, with the result that the plant and machinery at both factories are in first-class order in every respect. A great improvement has been made in the working of the Anchor Co.'s business. The company's rubber trade has been much increased, and a satisfactory profit has been made on that company's operations. Since the last general meeting two members of the board have died, Sir David Evans and Mr. W. O. Callender. Sir David Evans had been a director since March, 1903, but had been intimately connected with the company since

its formation as one of the trustees for the debenture-holders. Mr. W. O. Callender was the founder of the business. Although he retired from active management some years ago, he maintained until a few months before his death a keen interest in everything concerning the company and its affairs. By his passing away, this country has lost one of the pioneers of the electric lighting industry. The directors put on record their appreciation of the great and invaluable services which he rendered to the cable-making industry, as well as to the company ever since its formation. Mr. W. O. Callender was a director by virtue of a special article of association, and there is no vacancy caused by his death. Mr. John Varley has been appointed to fill the vacancy caused by the death of Sir David Evans. Sir J. Fortescue Flannery has been appointed a trustee for the debenture stock holders in the place of the late Sir David Evans. The dividend for 1906 was the same.

Great Northern Telegraph Co., Ltd., of Denmark.

At the general meeting held at Copenhagen on April 25th, the chairman and managing director, Commodore E. Suenson, said that the company's submarine system had not been subject to more frequent interruptions in 1907 than in previous years, although during the last two years the number of cables in Europe had been increased by four, the Shetland-Faroe-Iceland cable and the Denmark-Libau-St. Petersburg cable, each composed of two distinct sections. There had been 16 interruptions on eight cables in Europe, and 10 interruptions on seven cables in the Far East. The *H. C. Orsted* had been actively employed in Europe for 91 days; the *Store Nordiske* and *Pacific* had been on active service in the Far East for 151 days, of which 56 were for the account of other administrations. The working of the Vladivostock and Kiachta routes had continued to improve. By means of a direct service, which had been successfully established between Vladivostock and Irkutsk, Japan's traffic with England was now re-transmitted at only three places, Vladivostock, Irkutsk and St. Petersburg, and there was increased traffic by both routes. The new cable between Russia and Denmark had to be laid under great difficulties on account of the intricate nature of the Baltic Sea, and the laying consequently required a great deal of skill. The work was, however, successfully carried out in July by the cable steamer *Von Stephan*, belonging to "Norddeutsche Seekabelwerke" of Nordenham (Germany) which company had also manufactured the cable. The length of the eastern section of the cable (St. Petersburg-Libau) was 472 n.m. and of the western section (Libau-Stevns) 319 n.m., making a total of 791 n.m. In the ordinary circumstances the cable was worked direct between the company's St. Petersburg station and the Danish Telegraph Office at Fredericia, from which place six of the company's other cables landing in Denmark were worked. The telegrams between St. Petersburg on the one side, and England and France on the other side, could thus be sent by the new cable with only one re-transmission, to the great advantage of the service, as regards both accuracy and speed. The Iceland Cable had a most propitious inauguration last summer when the Faroe Islands and Iceland were honoured by the visit of H.M. King Frederick VIII, accompanied by several members of the Danish Parliament. The value of the cable for the meteorological service had been satisfactorily proved. They had acquired a large new building for the company's offices and station at Shanghai, the most important telegraphic centre of China. Parts of this building had been let to the Eastern Extension Telegraph Co. and the Commercial Pacific Telegraph Co., by which arrangement the exchange of telegrams between the three companies would be accelerated. The new offices, which were inaugurated on January 5th this year, contain all the most modern facilities and technical installations. In regard to the difficulties which arose in the Far East as a consequence of the great political changes in that part of the world after the last war, and of the approaching expiration of the company's exclusive privileges in Japan, complicated negotiations had been proceeding. In Japan the negotiations were continued up to February this year, when they were suspended in order to be resumed in Europe, during or after the International Telegraph Conference. The speaker went on to say that they could not pass by in silence the remarkable progress of wireless telegraphy during the year by the opening of a direct public service between Europe and America. The re-opening of the service after four or five years' silence was still far from being a complete success. Although the rates had been fixed at about one-half of those of the trans-Atlantic cables, the public, and even the Press, had hitherto made very little use of the new service, which suffered from slowness, uncertainty, and want of secrecy. However confident they felt of the absolute and lasting superiority of the telegraph by wire for the transmission from one country to another of political, commercial and private communications, the new invention had in the course of a few years made such remarkable progress that it might, nevertheless, in course of time perhaps become necessary to reckon with it, not only as a supplementary and auxiliary service, but also as a competitor of the telegraph by wire. The revenue account showed that the downward tendency in the receipts of the company had not yet ceased, as they decreased by about £13,200 as compared with 1906, owing to the same reasons as those mentioned last year, and, further, to the loss on exchange, which had amounted to about £5,000. As to expenses, "Salaries and Wages" had increased by about £6,520, and would continue to grow, the more so, as the enhanced cost of living appeared to have become chronic also in Europe. The board proposed the same dividend and bonus as in the previous year, viz., 20 per cent., of which 5 per cent. had already been paid as interim dividends. The chairman said that he had been obliged, on account of failing health, to ask for the consent of his colleagues on the board to his resigning the position of managing director in the course of the present year. The business of the company had gradually developed so much that in the future it would be impossible for one single person to attend to all the details. The board had therefore decided to substitute for the managing director a board of management, composed of several persons, who, in view of their personal qualifications and meritorious collaboration with the managing director, offered the greatest guarantee for the future effective administration of the company. This board of management would be chosen and organised in the near future.

Brisbane Electric Tramways Investment Co., Ltd.

This company's annual meeting was held on April 29th, Mr. H. R. Beeton presiding.

In moving the adoption of the report, the Chairman said that the results were better than for any previous year. He referred to the improved financial position of Queensland. In three years, without any extensions or material additions to their plant, and with very little increase in the mileage run, they had carried 33 per cent. more passengers, and had taken 25 per cent. more in receipts; the car-mile receipts had risen from 9¼d. to nearly 1s. in spite of a reduction of the average fare. The working expenses had fallen from 60 per cent. to 53 per cent. in spite of the increased cost of coal and labour. These results were due to the capable management of Mr. Badger. The total receipts were £159,230, an increase of £17,497, and the expenditure was £88,116, an increase of £5,345, a net improvement of £12,151. They held all the shares in the Brisbane Tramways Co., which had placed £15,000 to its renewals fund, and was paying in dividend £57,000 for the year. This enabled this company to pay 4 per cent. on the ordinary shares, after paying debenture and preference interest. £2,130 was carried forward. The current year was already showing a considerable improvement on 1907, and the tramway company was adding a new generating set and 12 cars. They had hoped to have had these in use by the August Agricultural Show, but the strike on Tyneside would delay the delivery of the generator. Their wages would be higher by £2,000 this year, as they had followed the Government by giving an eight-hour day, and they had also increased the wages of motormen and conductors by 6d. per day. Omnibus competition continued to decline. The sale of electricity for lighting and power continued to increase.

The report was adopted.

Swansea Improvements and Tramways Co.

The half-yearly report to December states that the directors have set aside out of the tramways undertaking profits £2,500 towards a fund for defraying or equalising the cost of extraordinary renewals of the permanent way and plant and equipment. Gross receipts amount to £27,816, being an increase of £2,741. After deducting debenture and other interest, £2,500 as above, &c., there remains £5,288, plus £3,442 brought forward, bringing the available balance up to £8,731. £2,000 is placed to reserve and depreciation, £295 to dividend on preference shares (6 per cent.), £1,004 dividend on preference shares (5 per cent.), dividend on ordinary shares (3 per cent.), and £1,531 is carried over. Increased receipts for the half-year are mainly due to the operation of the revised scale of fares. Expenses show an increase of £801, which is due to the payment of higher rates of wages to employés, increased cost of fuel, and increased expenditure on repairs and maintenance. During the half-year the liability of the company to sundry creditors has been reduced by £4,183, of which amount £3,500 was carrying a high rate of interest. The accounts of the Mumbles Railway and Pier undertaking for the year show gross receipts £23,369, and expenses £22,978. The net profit (£391) is payable to the British Electric Traction Co., on account of interest on moneys provided by them. The unfavourable weather affected the result of the year's working. On the tramways undertaking, power and running expenses were £9,490; repairs and maintenance, £3,317; and administration and general expenses, £2,202; 4,523,146 passengers were carried, as compared with 4,702,339 for the corresponding half-year of 1906, but the average receipt per passenger was 1·44d. and 1·24d. respectively, whilst the average expenditure per passenger was ·79d. and ·72d. respectively. Number of cars in stock, 65.

Kalgoorlie Electric Tramways, Ltd.

The annual meeting was held on May 6th, at Oxford Court, E.C., Mr. A. H. P. Stoneham presiding.

In moving the adoption of the report (see Electrical Review, May 1st, page 748), the Chairman said that the gross receipts for the year were £48,008, as against £51,000, a decrease of £3,000, a falling-off for which they were of course sorry. He thought that Kalgoorlie was entering upon a period of progressive, economic, and lasting prosperity. Unfortunately for them they were still compelled to maintain the high rate of wages to their employés. They would perhaps think that in times of depression wages would fall, but they had not fallen in Kalgoorlie, and that company was certainly not going to make the experiment of reducing the wages. They paid their men on an average 1s. 1½d. to 1s. 3d. per hour. One thing they could congratulate themselves upon was that

although the London money market was in a depressed state the company had been able to put away a certain sum for interest and sinking fund. That sum was fixed by the trustees for the debenture-holders. According to the trust deed they would redeem the "A" debentures in 17 years, and the "B" debentures in 26 years. However, some of the debenture-holders had been compelled by other circumstances to sell their holdings, which was a distinct advantage to the company, although a distinct disaster to the debenture-holders. If that state of affairs continued the result would be that they would be able to redeem the debentures several years before the stipulated time—perhaps the "A's" in 14 years and the "B's" in 20 years. The shareholders could rest assured that although they did not get a dividend now, they would get a satisfactory one when the company did start paying. As regarded the trans-Continental railway, they could get no definite information, but any one who watched Australian politics was confident that the Bill brought in by the Federal Government would be passed. That would undoubtedly be of benefit to Kalgoorlie.

Mr. Weatherhead seconded the motion.

The Chairman, in reply to shareholders' criticisms, said that they paid under their trust deed £15,000 a year, but if they could pay more, it would be applied to redeeming the "B" shares. As to the electricity supply, they were under contract with the Kalgoorlie Power Co. to take a supply for 10 years. They did consider the question of erecting their own station, but when they remembered that it would fall into the hands of the municipality at the end of their tenure, they abandoned the idea. The earnings per car-mile were 11·17d. this year, as compared with 11·33d. the previous year. As regarded the number of shares, it was really no fault of the company. The number of shares were fixed by the concessionaires at the time when the concession was granted at 250,000, although he thought they ought to be 50,000. However, they had never been offered for subscription, and as the average price paid for the shares was 3s. each, the capital should really be £50,000, instead of £250,000. The first quarter's working for this year showed, in comparison with the corresponding period last year, that there was a reduction in the receipts of £394, and the operating expenses had increased. As regarded the permanent way, that was in good condition; there was a sum of £3,000 set aside for renewals and repairs.

The report was adopted.

Cape Town Consolidated Tramways and Land Co., Ltd.

The directors have issued their report for the period from June 6th, 1906, the date of registration, to December 31st, 1907. After charging London administration expenses and trustees' fees, and crediting accrued interest and transfer fees, the profit and loss account shows a debit balance of £712, which has been carried forward. The estate companies and the Camps Bay Tramway Co. have declared no dividends since the reconstruction of the company. There is still virtually no demand for land for building purposes in the vicinity of Cape Town, owing to the serious depression in the property market and in general business. The board, however, have confidence that on any general revival of trade in South Africa, their residential estates will be among the first to feel the benefit. Meantime, they are being conserved at the lowest possible expenditure consistent with maintaining the estates in fair order and condition, and ready to meet any public demand which may arise for building sites. The Camps Bay Tramway Co., Ltd., have felt most severely the effects of the depression, and their accounts show a loss of £2,955. This figure includes a sum of £800, expended in legal and other charges in connection with the Kloof Line Amendment Bill. During the past year the Cape Colony Parliament passed the Bill which grants to the Camps Bay Tramway Co. relief from operating the Kloof Nek route to Camps Bay during the winter months, from May 1st to September 30th, except on certain stated public holidays. That route, besides being very expensive to work, is but little patronised by passengers on ordinary days during winter. Arrangements have been made to continue the winter service to Camps Bay by the Sea Point route.

Kalgoorlie Electric Power and Lighting Corporation, Ltd.

Mr. Roger Wallace, K.C., presided over the annual meeting held on May 6th at Winchester House.

In moving the adoption of the report (see Electrical Review, May 1st, page 751), he said that the reconstruction of the company had been effected, and, unlike the majority of electrical companies which when reconstructed involved a reduction in the amount of capital, in their case there had been an increase of capital to the shareholders. He thought they ought to be congratulated on that fact. The differences that had arisen between the holders of the founders' shares and the holders of cumulative preference shares had been adjusted to the satisfaction of all parties, and the directors had to thank the shareholders for their considerate attitude, which had enabled all the difficulties incidental to reconstruction to be overcome. The effect of that was that all the differences had been cleared away, and they were in a position to ask them to agree to the payment of a dividend on the ordinary shares. The trading account had been a record; it was not a record of increasing their charges, but of reducing their charges and doing a very much larger business with increased plant, and that plant had been built up mostly by means of capital found within the company itself, partly by the depreciation fund and partly by the issue of debentures. At any rate, the plant was in a far more efficient condition than ever. When they had put down the new units they would still further reduce the expenditure for producing their electricity. He thought that they could congratulate themselves that the load factor of their company was better—which, of course, was due to better management—than the load factor of any other company in the world. They had placed £7,500 to depreciation and renewals, and the new unit when put on would, of course, add to the efficiency of their plant. One of the disadvantages that they, as a supply company, had to contend with, was that gentlemen from Germany, and also from this country and elsewhere, always devised new means of producing power, and were always holding out that they were cheaper—means that had been known over here for some time but which had not been heard of out in Australia. Recently gas engines were introduced out there, but it was most essential that in the means of producing power they should take into consideration the condition of climate, temperature, &c., and it was imperative upon the technical adviser to use his acumen in exercising the discretion as to which class of plant to use. Although he (the Chairman) did certainly at one time think there was a field for gas engines in Australia, that had not proved to be the case, and they would not do for the people of Kalgoorlie. The mine-owners used these offers of various kinds of means of producing power as a lever to get them to reduce their prices, and he could assure them that the negotiations were at times very difficult. The directors worked with the idea of getting as much work as possible, so as to ensure a fair dividend. They were successful in declaring a dividend this year—it was not a large dividend, only a living dividend—and they hoped by increasing their business to increase the dividend. He would like to call the attention of the Australian Government to the necessity of doing their utmost to encourage other industries besides mining if they wished Australia to be a prosperous country. He did think it would be much better for the Government if instead of discussing politics and fiscal policy they would consider the question of promoting other industries outside that of the country.

Mr. Pope seconded the resolution, and the report was adopted.

Eastern Telegraph Co., Ltd.

For the six months ended December 31st, 1907, the directors report a revenue of £595,483, less £198,229, for the ordinary expenses, and £63,527 for expenditure relating to maintenance of cables, depreciation of spare cable, sundry differences in exchange, and income-tax payable abroad, leaving a balance of £333,727 plus £41,651 brought forward, making a total available balance of £375,379. After providing for income-tax payable in England, interest on mortgage debenture stock, and dividends on preference stock, which in all absorb £82,584, there remains a balance of £292,795, out of which the directors have placed £7,000 to reserve fund for maintenance ships, and £70,000 to the general reserve fund, and have paid an interim dividend of 1½ per cent. on the ordinary stock, amounting to £50,000. The directors recommend a final dividend on the ordinary stock of 1½ per cent. and a bonus of 2 per cent., amounting together to £130,000, making a total distribution of 7 per cent. for the year. £35,795 is carried forward.

The ordinary general meeting was held on Tuesday, at Electra House. Sir J. Wolfe Barry, K.C.B., in moving the adoption of the report, said that in consequence of the alteration in the period covered by their financial year they were unable to offer the customary detailed comparison of income and expenditure, as they had no accounts for the corresponding period of 1906 with which to compare them. However, the aggregate receipts for messages during the half-year compared favourably with those for the corresponding period for 1906. The receipts from messages exchanged with South Africa, however, continued to decline, there being a considerable falling off in all classes of that traffic. On the other hand, the traffic with India showed a slight improvement, and there was again a steady increase in the message receipts from traffic with South America, so that, on the whole, there was an increase in the message receipts of about £5,000. As regarded the expenditure, it might, perhaps, be convenient, as they could not make a comparison with the corresponding half-year in 1906, to make some comparison with the accounts for the preceding half-year to June 30th, 1907, and, in doing so, he might state that the total expenses for the half-year, exclusive of repairs to cables, showed a decrease of about £3,600 as compared with the previous half-year. When they turned to expenses attending maintenance of cables they found that the cost for the half-year under review was nearly £22,000 more than it was for the preceding half-year. As he had so often stated, the expenditure under this heading was and must be extremely variable, being dependent upon the number of interruptions of their cables, and to the extent of the consequent repairs, in addition to which the credit to this account in respect of charters of their repairing steamers by foreign Governments and other telegraph administrations might, of course, be more or less than that received for the corresponding period. In the present instance both those factors told against the present half-year, as not only had they been obliged to lay in nearly double the quantity of new cable on repairs to their own lines, but the credits in respect of charters, &c., were nearly £9,000 less than they were for the half-year to June, 1907. In view of the present lack of elasticity in the revenue and the continued depression in South Africa, which was adversely affecting their receipts, the

directors considered it advisable to carry forward to next account a larger balance than was usual at the end of the financial year. They had, therefore, decided to carry £70,000 to the general reserve fund this half-year and to carry forward to next account £35,000. The general reserve fund now amounted to £1,144,730. This was satisfactory as far as it went, but they trusted that the traffic would improve to enable them to raise their contributions to this fund, while maintaining the reasonable dividend and bonus which had remained constant for so many years. With a cable system such as theirs now amounting to a total length of 41,069 miles, it was absolutely necessary that their reserve fund should be sufficient to provide, not only for important renewals of the various sections as they deteriorated through age and other causes, but also to enable them to increase their carrying capacity from time to time as the traffic grew from the development of the world's commerce or other causes which stimulated the volume of telegraphic business. It was by reason of their reserve fund that they could from time to time meet all the requirements of the telegraphing public, and the best interests of the public were to be found in the financial strength of the company, because this alone had made it possible for them to adopt reductions in the tariff and to grant improved facilities to those interested. Very important renewals had been recently completed on one of their cables in the Indian Ocean, the cost of which would be charged against their reserve fund account next half-year. During the half-year their cable-steamer *Duplex* had undergone extensive overhauling in England, and had been furnished with a new boiler, and, in accordance with their usual custom, a portion of the cost had been applied from the maintenance ships fund. They would see from the report that the International Telegraph Conference was now sitting at Lisbon, where this company was represented by the managing director, Sir J. Denison-Pender, Mr. F. A. Johnston and some of the officials of the traffic department. As they might be aware, nearly all the countries in the world were represented at this Conference by officials appointed by the various Governments, and although telegraph companies were invited to express the views of their companies upon the different questions under discussion, they were not permitted to vote on any subject, even though it might be one of vital interest to them. In debates on future action they had, therefore, to depend upon the justice of their case and the arguments which they were able to bring forward combined with the submission of facts and figures which their representatives, owing to their great experience in such matters, were able to submit to the deliberations of the Conference. These, together with the support of their own Government representatives, ought, he hoped, to result in solutions of questions affecting cable telegraphy in a manner fairly satisfactory to the companies, as also to the interests of the public, because, after all, the interests of the State and of the telegraphing public should be identical with those of the cable companies, and it was their constant endeavour to work with this aim in view. Although the directors had always been prepared to meet the reasonable demands of the public for reductions in tariff, it must be borne in mind that the carrying capacity of cables was limited, and that if tariffs were reduced beyond a certain point, the work not only became unremunerative but would actually entail a loss to the company. Therefore, in the event of future demands on them to make any further reductions of tariff they must look to the Governments concerned to assist them either by the extension of the standard revenue system which had been found to work satisfactorily for Indian and South African traffic, or by some other method which might be mutually beneficial. They had every confidence in their representatives at the Conference, and also in the justice of the numerous delegates from the various Governments, that nothing would be done to impair the present efficient working of their cable system, which was all-important to the welfare of the world.

The Marquis of Tweeddale seconded the motion.

The Chairman, in reply to shareholders, said that the International Conference to which he had referred had, of course, no power to compel them to reduce their tariffs—they could only urge them to do so. As to wireless telegraphy, he did not think that system was represented at the Conference, it did not seem to have arrived at that solid position which would justify its being represented. With regard to allowances to the older members of the staff, of course the pension fund had not yet been in existence long enough to meet all the demands in that respect. It was approaching a capital of nearly £100,000, which amount would, he believed, be considerably increased at the next quinquennial valuation in June. They had a superannuation fund for the purpose of dealing with the older members, and as the pension fund grew the necessity for the superannuation fund decreased. The retiring age of the company's servants was now 55, and in order to deal with that the company had voted a considerable sum of money. He was glad to say he knew of no single case in which the directors had been obliged to deal in a parsimonious manner on account of want of funds.

The report was then adopted.

Edmundson's Electricity Corporation.

On May 6th a meeting of the holders of the £480,000 first mortgage debenture stock was held in the Great Hall of Salisbury House, under the chairmanship of Mr. H. Ansell, to consider a resolution to sanction a supplemental trust deed in connection with the proposed issue of prior lien debenture stock. At the commencement of the proceedings objection was raised by several stock-holders to the fact that Mr. Ansell was in the chair.

The Chairman said he was appointed under the trust deed to act as chairman by the trustees of the debenture-holders—viz., Sir James Bailey and the Anglo-American Debenture Corporation. He called on the chairman of the company to move the resolution.

Mr. P. D. Tuckett, in moving the resolution, said that he had carefully considered what he was going to say, and spoke with a full sense of responsibility. He asked them to believe that every word he said he absolutely believed and meant. He was most anxious to explain the position fully, for, from letters which he had received and from the fact that some of them had been willing to sacrifice their holdings at the prices recently ruling, he felt sure that the real position was far from being appreciated. They deplored as much as anybody, the necessity of resorting to the creation of prior lien debenture stock. They did so only because they believed that this expedient offered the one practicable and satisfactory way of escape from the difficult position in which the company now found itself, and, at the same time, afforded the only means of securing the financial stability of the company. There was no question of their interests being sacrificed, although, naturally, no debenture-holder welcomed the creation of a charge ranking ahead of him; but not only would their interests be amply safeguarded, but their position would be actually improved. What immediately concerned them that day was the fact that the present position existed, and it was sufficient for him to call their attention to the present net income of the company and to the present prices of the company's stock and shares to make it obvious that it could not be met, and that further capital could not be raised by any ordinary means. Coming to the reasons which made it necessary to resort to the creation of prior lien debenture stock in order to raise the necessary capital, he shortly enumerated the possible alternatives. The first one was embodied in the suggestion that they should go slow and rely on surplus profits. They had no intention of going fast, and they had every intention of utilising surplus profits; but, unfortunately, such realised surplus profits as they might have, would not go far to develop the business of between 30 and 40 young and growing stations. During the next four years they expected to rely on a surplus profit of £50,000; but it might be three or four years hence before the bulk of that amount would be forthcoming and available, and in the meantime the best part of £200,000 might be wanted. That, therefore, disposed of that alternative. The next one was the assessment of the shares. Apart from the difficulty involved in liquidation, and apart from the fresh difficulty introduced by the recent decision in the case of Henderson's Transvaal Estates, was it reasonable to suppose that the price at which the shares now stood would admit of an assessment sufficiently heavy to provide the funds necessary to safeguard the financial position and enable them to carry on the business with any assurance of success? He was entirely in accord with them that it was no business of debenture-holders to sacrifice their interests in coming to the rescue of distressed shareholders, and, if there were any other alternative open to them, which would not be more detrimental to their interests than the course they proposed, they should certainly adopt it. As it was, it was quite clear that, from the shareholders' point of view, the position was so bad and their prospects so comparatively remote that they could not be expected to make the sacrifice necessary to protect their holdings, more especially as there was an alternative, to which they could, and must, resort if they refused their consent. And, after all, even though they were mere creditors of the company, there was no question that their interests were very closely bound up with its welfare, and there were cases—and this was one of them—where it was incumbent on debenture-holders in their own interests to come to the rescue. The last and only practicable alternative was to be found either in the issue of further debenture stock or Urban debenture stock, or in the realisation of the most saleable of the company's assets. It would be suicidal to have recourse to either of these expedients at the present time. Two or three years hence it might very possibly be desirable to resort to them, but just now it would merely involve a needless sacrifice, without necessarily avoiding a prior lien debenture issue after all. Moreover, at best it could only prove a hand-to-mouth policy, and one, therefore, which was fair neither to the board nor to themselves; for, if there was to be any reasonable chance of their redeeming the position and restoring the value of their security, the first essential was to put the company on a sound financial basis. Till that was done they would be forced to muddle along as best they might, their time would be occupied in the constant anxiety of finding ways and means for carrying on the business from day to day, and they would be unable to concentrate their attention on the many details of the business which urgently needed it. It would, moreover, be impossible to go forward with any assurance of success, or even of their being in a position to pursue a consistent policy. There was no question as to the absolute necessity for the creation of this prior lien debenture stock, or of its being primarily in their interests. The inevitable consequence of their refusing consent must be that the company would become a more or less derelict concern with their stock permanently depreciated in value. On the other hand, the creation of the prior lien debenture stock could not fail materially to increase the value of the security, and immediately and substantially to improve the price of the stock. Indeed, he entertained no doubt himself that, so far from losing anything by the company's misfortunes beyond the severe, but, he hoped, temporary, drop in the price of the stock, they were likely positively to gain thereby. The present difficulty, so far as they were concerned, was a financial one, and although it was true they would have stock ranking ahead of them, that stock would be represented by additional assets of equal or greater value, and would be offset by advantages of a very real and substantial kind. The figures for the past year would not be available till July; but if they should appear, at first sight, to compare unfavourably with

those of previous years, they must not jump to the false conclusion that their security was in jeopardy, since such a result, should it occur, would be the direct outcome of their avowed policy of strengthening the real foundations, by providing for depreciation hitherto unprovided for, and by lopping off credits which did not, in fact, exist. Their aim would be so to strengthen the company's financial position by financially strengthening the position of the subsidiary companies as to preclude the possibility of a recurrence of the present difficulties. So that, provided the gross profits of the subsidiary companies showed satisfactory expansion, and were properly dealt with, they need have no anxiety because, during the next few years, they neglected mere appearances and showed no large margin over and above the amount required to meet the interest on the stock. The future development of the business was not without several elements of anxiety, in consequence of which it was very difficult to forecast, with any degree of accuracy, the prospects of the shareholders; but, unless the whole industry of electricity supply was doomed to collapse, and the tendency pointed all the other way, there was every reason to regard the business as a perfectly sound, stable and progressive one, with an increasingly prosperous future awaiting it. Failure hitherto had resulted, not so much from any inherent unsoundness in the business as a whole, as from the way in which it had been conducted; for, although there was no doubt that the supply of these small provincial towns demanded the most careful attention to detail, and the most rigid economy, both as regarded capital expenditure and working expenses, if a satisfactory return was to be realised, there was no reason to suppose that they could not be made to realise a moderately satisfactory return, given these necessary conditions, and, therefore, without suggesting that they could undo the mistakes of the past or render highly profitable undertakings whose capital was already inflated, or whose existing commitments might hamper their freedom of action, he saw no reason why the position should not be materially improved. If once the financial position was satisfactorily provided for, he felt satisfied that a steady, if slow, improvement was assured. Beyond any question, whatever the losses and prospects of the shareholders might be, they were amply and absolutely secured. Neither now nor in future was there any question of their failing to meet their debenture interest, or of their failing to recover their capital in full, if their doing so enabled them to enforce their security. He desired to be most emphatic on this point, which brought him to the consideration, why, under these circumstances, they did not foreclose. The answer was that it was not open to them to foreclose, they had made no default, and they were in no danger of making any default which would entitle them to do so. Now, with reference to the issue of prior lien debenture stock, he was not prepared to say more than this: That, subject to their approving the creation of the stock, they proposed to make an issue at an early date and to give them an opportunity of subscribing. There could be no question as to the stock being extremely well secured, or as to its yielding a handsome return having regard to the security, so that he hoped they might rely on them to avail themselves of the opportunity, and so improve the value of their existing stock by ensuring the financial stability of the company. He then briefly recapitulated the main points of the position which he had tried to put before them. They were a new board, not without experience of the business. They enjoyed the very great advantage of Mr. Highfield's services. It was too early yet for them to be able to say how far they were likely to succeed; but he would say that they were determined to succeed so far as human effort and care and the inherent difficulties of the position would enable them to do so.

Mr. Beeton seconded the resolution.

Mr. Swan asked if Mr. Beeton was a debenture-holder.

The Chairman said he was not, and then a gentleman in the body of the hall seconded the resolution.

Mr. John Page said he had been instrumental in issuing a circular on behalf of the Defence Committee for the debenture-holders. He thought their position was serious, for if they passed the resolution they would be no longer first debenture-holders. On all occasions of this sort the Chairman was full of optimism with generally a few threats as to ruin. He asked them to consider the position as it stood. To-day their security was good, but whether it would be good when £200,000 was placed before it depended on a host of circumstances. He complained that Mr. Tuckett never took them into his confidence. He stumbled over the figures, but surely two months after the end of the financial year the corporation must know the figures for the different stations. If the company asked the debenture-holders for a favour they ought to tell them what the facts were. The Chairman's hint about the expenditure of £10,000 referred to the Scarborough tramways, on which £80,000 had been sunk without profit. The Chairman had picked out certain paragraphs from the Committee's report which were favourable to him, but he neglected to quote the paragraph which stated that at the end of 1906 the total depreciation set aside by the subsidiary companies was only £32,775 on a capital expenditure of £2,950,000. What confidence had they that any new money would be wisely expended? (A voice: "There is a new board.") Did they know anything of the new board? (A voice: "Yes, more than you do.") He moved as an amendment—

"That the resolution submitted by the directors be amended as follows:—That the amount of prior lien debenture stock to be issued shall not exceed £100,000; that the said £100,000 be raised in two separate amounts of £50,000, the first £50,000 as soon as the board likes, but that a committee of debenture-holders be appointed to investigate the financial requirements of the corporation before the second £50,000 is issued."

Mr. Swan seconded the amendment.

Mr. Cuffe asked what advice the Anglo-American Debenture Corporation gave in the matter.

Mr. Bingham said the speech of the chairman was very bland, but it contained little which should commend the resolution to the debenture-holders. He considered the words of the chairman were entirely illusory. He took it that the assets were sufficient to cover the debentures, and if they were asked to grant concessions they ought to get a valuable favour in return. He was convinced that the right thing for the debenture-holders to do was to hold a tight grip on what they had.

The Chairman, in reply to Mr. Cuffe, said he saw no means by which the debenture-holders could get possession of the assets, as the company had committed no breach of the trust deed. The trustees came to the conclusion that although they could not take any strong line on the matter, yet the proposals of the board were the best.

After further discussion, a motion to adjourn the meeting was carried by a show of hands, and the board demanded a poll. This was eventually withdrawn, and the board agreed to an adjournment till the 14th inst.

Berlin Elevated and Underground Railway Co.

The report of the Gesellschaft fur Elektrische Hoch und Untergrundbahnen, of Berlin, states that the traffic during 1907 increased in about the same proportion as in the preceding 12 months. During the year the work of construction lay in the extension of the railway on the one hand through the business quarter between the Potsdamer Platz and the Spittelmarkt, and on the other in the direction of the external prolongation to the Westend, and negotiations with the State and local authorities were opened with the object of obtaining consent to complementary lines. The total length of elevated and underground sections at the end of 1907 was 7·93 miles as compared with 7·81 miles at the close of the previous year, whilst the level line remained stationary at 1·34 mile as in 1906. The financial position may be summarised as follows for the past two years:—

	1907.	1906.
Ordinary share capital	£2,000,000	£1,500,000
Loan capital	1,248,560	750,000
Gross profits	155,628	148,544
Renewals fund provision ...	23,500	20,000
Taxes paid to city authorities ...	6,617	5,729
Depreciation provision	3,471	3,175
Net profits	86,975	85,814
Dividend, per cent.	5	5

The number of passengers carried on the elevated and underground railway advanced from 37,810,000 in 1906, to 41,440,000 last year, and the average receipts per passenger rose from 1·50d. to 1·52d. in the same periods respectively, whilst the level section transported 4,380,000 persons in 1907, as compared with 3,790,000 in the previous year. Having regard to the impending opening of extensions of the main railway, the company ordered further rolling stock, the delivery of which will raise the total to 201 carriages, of which 114 are motors-cars. The power station in the Trebbiner Strasse was enlarged, and a site for a second power station had been secured not far from the Westend. The first portion of the underground line to the Spittelmarkt had been opened, and the whole of the section would be completed in the current year, whilst the extension to the Reichskanzler Platz, in Charlottenburg, had also been thrown open to traffic. It should be mentioned that, although the share capital at the end of 1907 stood at £2,000,000, the amount paid up at that time was £1,625,000.

South Metropolitan Electric Tramways and Lighting Co., Ltd.

The annual meeting was held on Monday at Donington House, Mr. C. G. Tegetmeier presiding.

The Chairman, in proposing the adoption of the report (see Electrical Review, May 8th, p. 793), said that the operations of the company for the past year had resulted in a net profit, after payment of debenture interest and of all expenses chargeable to revenue, of £8,477, as compared with £4,717 for the previous year. Traffic receipts from the tramways, together with the advertising receipts, amounted to £41,847, as compared with £17,820, but as, during 1906, the tramways, which amounted to 13 route-miles, were opened in sections, no useful comparison could yet be made. During the past year they had had to contend with exceedingly unfavourable weather conditions. The Croydon to Tooting section, which was daily becoming more popular, ran for the greater part of its length through Mitcham Common, and depended very largely upon pleasure traffic, but the extension of the L.C.C. system to Tooting Junction within a few feet of their terminus there formed a most important link in the tramway system in the South of London, and brought their system into direct communication with that of the L.C.C. and of the London United Tramways. The Croydon to Sutton section ran at present through a good deal of open country, which was, however, rapidly becoming populated,

but until that development had made further progress, and the cornfields and market gardens, which at present were characteristic features of a considerable portion of the route, had given place to dwelling houses, they must expect that this section also would be largely affected by weather conditions. Neither of the two sections to which he had referred furnished at present the traffic which was expected from a metropolitan line. In constructing them as double lines throughout, they had had in view the prospective requirements of the district, and in a sense the capital employed on construction as double track was not at present fully productive. They had no doubt, however, that the policy of providing a double track in the first instance, instead of a single one with a heavy additional expenditure later on in doubling it when the traffic had rendered it necessary, would in the near future be fully justified. The Penge section was not affected by bad weather to quite the same extent as the other two sections. The arrangement with the Croydon Corporation for through runnings, to which reference was made in the last report, had now been fully established, and the facilities thus provided had been much appreciated by the public, as the increased traffic on that section indicated. That their system was popular was shown by the fact that they had carried nearly seven million passengers, and the average fare had increased from 1·26d. to 1·43d. per passenger, indicating that there was an increasing number of long-distance travellers. Turning to the expenses, power and running amounted to £21,119, and repairs and maintenance to £5,045. Of the power and running, £9,287 represented wages, and £10,720 represented cost of current. Of the latter amount £7,110 was paid to the Croydon Corporation, and £3,150 to the Beckenham Urban District Council, the balance of £459 being the cost of the current supplied from their own power station. The price paid to the Croydon Corporation was 2d. per unit, and the average price paid to the Beckenham Council was 1·98d. per unit. The obligation to take current from the Croydon Corporation was imposed by Act of Parliament, and the arrangement with the Beckenham Council was one of the conditions under which the company acquired the undertaking. Those prices for current were very high having regard to the present cost of generating electricity on a large scale. With regard to the electricity supply portion of their undertaking, the gross receipts amounted to £7,391 as compared with £5,435 for the preceding year. The working expenses amounted to £3,927, leaving a surplus of £3,444 as compared with £2,671 last year. But they had written off profits the sum of £469 for depreciation in respect of batteries sold, which reduced the balance carried to profit and loss to £2,975. Although the receipts showed very satisfactory progress, and the number of consumers a very satisfactory increase, the expenses had increased considerably, owing to the increased price of coal, and the profit would have been at least £400 more had they been able to purchase coal at the same price as in 1906. The experiments which they were now making at their power station would, they hoped, enable them to effect a considerable economy in their fuel during the current year. The recent development in the metallic filament lamp might be expected to exercise a very considerable influence upon their lighting business. Those lamps took about one-half or one-third of the current required for carbon lamps giving the same candle-power, and their general adoption would, no doubt, lead to a material decrease in the consumption of current per customer. It might be thought that that would be detrimental to the growth of their revenue, but their area of supply was a very large and important one, and their business was capable of great extension, and he thought it would be found that the increased popularity of electric light by reason of its being the cheapest, in addition to its being the best form of artificial light, would more than make up in an increased number of consumers for any lessening in individual consumption. The directors regretted that the profits did not as yet permit of any appropriation being made towards a depreciation and renewals fund and a sinking fund for the redemption of the company's debenture stock. It was, however, the policy of the board that reserves for those purposes should be built up as speedily as practicable. Of the additional capital outlay of £40,580, the bulk was in respect of the balance payable to the contractors for the work in connection with the construction of the tramways and the equipment of the generating station, and did not represent further commitments into which the company had entered during the year. A considerable portion of the expenditure was incurred for extensions to the mains, and except to the extent that they would require to expend more money for that purpose and for the general development of their lighting business, their capital commitments might now be regarded as practically at an end. On December 31st they had still to receive £9,375 in respect of the amount then outstanding on the preference shares, which they had allowed to remain unpaid by arrangement with the shareholders until the money was actually required. The money was called up from time to time as it was needed, and of course only carried interest from the date of payment. Since the close of the year they had instituted a parcels delivery system in connection with the tramways. It would be readily seen that their frequent service placed them in a position of being able to offer unequalled facilities in the way of rapid collection and delivery of parcels. The system was only inaugurated on April 6th, and it was too early yet to forecast the results, but they had good reason to anticipate that the scheme would receive public support, and that it would furnish an additional source of profit. As stated in the report, the company had joined the British Electrical Federation, Ltd., which had been formed by various traction and lighting companies for the purpose of co-operation and joint action in matters of common interest.

Mr. J. Devonshire seconded the motion, and the report was adopted.

National Electric Construction Co., Ltd.

The report of the directors to December 31st, 1907, states that the gross profit for the year is £29,776, and deducting therefrom expenses of administration, &c., there remains a balance of £18,117, plus £2,343 brought forward, making a total of £20,460. The directors recommend that this be dealt with as follows:—Reserve, £3,000; expenses of, and discount on debenture issue, £4,488; reserve against capital charges on town lighting installations, £1,200; transfer to debenture redemption fund, £1,550; reserve to cover doubtful debts, £500; depreciation on free wired installations, £451, and on furniture, fixtures, plant and tools, £223. Carry forward £9,049. In view of the large investments of the company in tramway and lighting syndicates, which, owing to delays in construction beyond the company's control are not yet realisable, the directors recommend that the balance at the credit of profit and loss account, amounting to £9,049, be carried forward to this year's account.

The depression which prevailed during the year under review appears to be passing away, and it may now be possible to finance some of the concessions secured before the depression set in. Negotiations are in progress to this end, and the directors anticipate that arrangements to enable at least two of the concessions to be dealt with will shortly be completed. Should these hopes be realised, the directors will take into consideration the declaration of an interim dividend. The debenture issue referred to in last year's report was successfully placed, and the directors recommend that the expenses connected therewith should be written off. The annual premium on the sinking fund policy for the redemption of the debentures at maturity, which is being provided for out of profits, should be sufficient for depreciation in the future, unless circumstances make it necessary for special provision to be made in respect of any particular asset.

Musselburgh and District Electric Light and Traction Co., Ltd.—A strike of the employés occurred during the busiest months of the year, and, although this was successfully dealt with, the profits naturally were affected to a considerable extent. Powers for the extension of the tramways to Port Seton have been obtained, and there should be a substantial increase in the profits of the company when this extension has been constructed.

Torquay Tramways.—Considerable and unavoidable delays prevented the completion of this system; the last part of the route, namely, the Torbay Road, has, however, just been opened and passed by the Board of Trade, and the receipts are most gratifying. It will be necessary to have additional cars to cope with the traffic.

Mexborough and Swinton Tramways.—These were only completed in August, and the traffic there also calls for additional cars, which are now being made. Important alterations to the system have been found necessary, and these should be completed in the course of the next three months.

Rhondda Tramways.—There have also been unavoidable delays in the completion of this system. The Taff Vale Railway Co.'s opposition resulted in two arbitrations and appeals to the Court, which were decided against the railway company, with costs. The Rhondda Urban District Council are under obligation to carry out certain road improvements and widenings to enable the tramway lines to be laid. These works have not yet been completed, but an agreement has been arrived at, and approved by the Board of Trade, under which the works should be completed by June 30th next. Owing to financial difficulties, the South Wales Power Co. were unable to supply current for the tramways, and it therefore became necessary to erect a generating station. A company called "The Rhondda Tramways Electric Supply Co., Ltd.," was formed, and the capital raised. The work is nearing completion, and it is expected that two sections of the tramways will be opened in the course of a few weeks.

Oxford Electric Tramways.—The present horse tramway system had to be acquired, and satisfactory terms have been arranged with the horse tramway company.

The progress of the Bo'ness and Carnarvon electric light undertakings has been maintained, although the high price of fuel has affected the profits, as with similar undertakings throughout the country.

Mr. L. B. Schlesinger presided at the meeting held on Monday at Winchester House, E.C., and, in moving the adoption of the report, he referred to the great financial depression of the year, making it practically impossible to raise capital for industrial enterprises, particularly those connected with the electrical industry. Having regard to all the circumstances, the results could not be called unsatisfactory, notwithstanding that, owing to the commitments of the company, they recommended that the balance be brought forward to next year's accounts. The balance-sheet showed sufficient to pay a 5 per cent. dividend, and they had indicated the possibility of an interim dividend being declared later on. The chairman then went in some detail into the various local undertakings of the company. The Torquay contract had now been completed, the Torbay Road line having been opened for traffic just before the Easter holidays. The Corporation's consent to the construction of the tramways along the Torbay Road was only given early this year, and they completed the work in about six weeks, although the time allowed was three months. The receipts on the completed system had so far been excellent, averaging about 12·18d. per car-mile. Given reasonably good weather, this undertaking should earn a large revenue. With regard to the Mexborough and Swinton tramways, the results to date had satisfied them that there was a large travelling population, and that the

investment should be a profitable one to the company. Unfortunately, however, they had had a great deal of trouble with the Dolter surface-contact system, and had decided to have the overhead installed. The orders for the materials had been placed, and the work would be put in hand at once, with the view of having a considerable portion of the system equipped and ready for the Whitsuntide holiday. This was the first Dolter system installed in this country, and as the result the Torquay and Hastings systems had been improved, and appeared to be a success. At Mexborough considerable expenditure would have been necessary to make the system as efficient as at Hastings and Torquay. The various other undertakings were referred to in some detail, and the Chairman concluded by saying that in regard to the financial depression there were signs of improvement, but he was afraid that it would be some time before capital could be raised, even for the best of schemes.

A Shareholder asked whether the work at Mexborough was being done by the Dolter Co. under their contract. He was under the impression that they were liable in regard to the matter.

The Chairman said that the Dolter Co. were liable under the contract to replace the system.

Mr. Fowler, in seconding the report, referred to Mexborough, and said that as to the Dolter matter, that had been a very great disappointment to them, but they were perfectly justified. They took every possible steps to see whether it was likely to be a satisfactory system, and had it turned out very well they would have been congratulated upon their foresight.

The report was adopted.

Lisbon Electric Tramways, Ltd.

For the year 1907 the directors report that after deducting interest and amortisation due on the debentures of "The Companhia Carris de Ferro de Lisboa," and after the payment of £25,000 for interest on the debentures of this company, and the payment of London office expenses and directors' remuneration, there is a net profit of £92,803, plus £15,711 brought forward, making £108,514. From this £35,000 has been placed to depreciation, and after writing off £9,077 from this account for renewal of permanent way, the balance to credit of depreciation reserve account amounts to £135,923. This reserve is indispensable, and indeed still further increase is necessary in view of the fact that the track and plant generally have been in constant use for many years, and will now require renewals from time to time. £5,000 has been added to the credit of exchange reserve account, making this account £20,000. The usual preference dividend (£25,533) has been paid, and the directors recommend a dividend of 5 per cent. for 1907, amounting to £29,709 on the ordinary capital of £594,188, leaving a balance of £13,271 to be carried forward. The political unrest and financial depression throughout the country, together with the effect of the abnormally bad weather during the year, have combined to check that steady increase of traffic which might otherwise have been expected. The operating expenditure also shows a considerable increase due to the enhanced price of coal and other supplies; but, notwithstanding these drawbacks, the operations of the company during the past year have practically maintained the satisfactory figures of the previous year. Capital expenditure amounted to £72,271, mainly on additional machinery, rolling stock, cables, and the electrification of the lift on the Elevador Do Carmo. The lease of the Elevador Do Carmo, entered into in the previous year, has resulted in a fair return being earned on the expenditure incurred. The directors again testify to the valuable services rendered by the directors of the local board in Lisbon, and also by Mr. William Clark, the general manager, and by the entire staff.

Potteries Electric Traction Co., Ltd.

The annual meeting was held on Tuesday at Donington House. Mr. G. F. M. Cornwallis-West, in moving the adoption of the report, referred to the continued wet weather of last summer. In spite of those adverse conditions the traffic receipts, including parcels, had increased from £94,877 to £97,416, an increase of £2,539, without any increase in the route mileage. The passengers carried showed an increase of 517,309, the total number being 19,665,634. For two years past he had referred to substantial decreases in the power and running expenses, and this year he was able to do so again, the figures showing a reduction of over £700. That was all the more satisfactory considering the difficulty that had been experienced with fuel during the past year. They had had to contend with increased prices for coal, and the quality in spite of that had deteriorated. Their fuel alone last year cost them £460 more than in the previous year, so that but for that there would have been a still further reduction. The item of repairs and maintenance had increased, the figures being £18,216, as against £16,250. Of that amount the large sum of £6,299 had been expended on the permanent way, and a considerable increase in expenditure on repairs and maintenance of rolling stock had also been incurred, £9,324 having been expended under that head, as against £8,710 in 1906. A large proportion of that increase was due to the unfortunate snowstorm in the Christmas of 1906. Although those figures showed an increase, the policy of keeping in an efficient state of repair both the permanent way and the rolling stock was not only a wise one, but was absolutely necessary in the interests of the shareholders. The administration and general expenses had slightly increased, but for the first time for several years a reduction was recorded in the amount paid for rates. There was a small reduction in insurance, the third party risks being now run entirely by the British Electrical Federation. The various associated companies of the B.E.T. Co. were placed into groups according to the various risks, the standard of the risks having been arrived at on the average amount of claims paid for a certain number of years past. They were in the bottom class, and he trusted they might remain there. One of the great advantages of that scheme of mutual insurance was that the company paid exactly cost price—no profits going to any insurance company. The capital expenditure had only amounted to £3,880, the major portion of which had been expended on doubling the line in Brickkiln Lane. £400 had been expended in the conversion of one of their motor-omnibuses into a motor char-a-banc. The manager had come to the conclusion that there was better scope in the district for char-a-bancs for pleasure traffic than for ordinary omnibus traffic. They proposed to add £3,500 to the renewals suspense account, which they started last year, and that with the credit balance brought forward, made a total of £4,523. £7,474 had been expended during the year on that account, showing a debit balance of £2,951. On the other hand, the estimated expenditure under that head this year was only £2,550, or about one-third of what it was last year, and assuming, therefore, that similar amounts were placed within the next two years to the account, the amount should be wiped out within four years. In conclusion, the chairman said that the company had joined the British Electrical Federation, which had been formed for the mutual benefit of all the companies.

Mr. Stephen Mear seconded the motion, and the report was adopted.

Underground Electric Railways Co. of London, Ltd.

Sir Edgar Speyer presided on Monday, at Hamilton House, over an extraordinary general meeting of this company called for the purpose of passing resolutions approving of the G.N.P. & B. Railway Co.'s Bill, approving of the scheme of April 7th last for the conversion or exchange of the profit-sharing secured notes of the company, and agreeing to voluntary winding up, with Sir G. Gibb as liquidator, for the purpose of carrying the scheme through.

Sir Edgar, in moving the adoption of the resolutions, referred at some length to the various influences that had militated against the success of the company, an unfavourable money market, delays in completion of undertakings thus adding to expenditure, Parliamentary and local burdens making the cost of tube construction more costly than it should be; motor-bus competition, L.C.C. low tramway fares, high rate assessments, over-sanguine estimates by experts as to traffic development—experts who did not appreciate the difference between London and New York and Chicago. The engineering side of the undertaking had met all expectations. After further words from the chairman concerning the outlook for tubes, the resolutions were carried.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

Newcastle-upon-Tyne Electric Supply Co., Ltd.—Provisional certificates for a further issue of 50,000 ordinary shares of £5 each (issued at £6 per share), fully and partly (£3) paid, of which £2 is capital and £1 premium; and 50,000 5 per cent. preference shares of £5 each, fully and partly (£2) paid.

And to allow the following to be quoted in the Official List:—

Calcutta Tramways Co., Ltd.—Further issue of 3,176 5 per cent. cumulative preference shares of £5 each, fully paid.

Rangoon Electric Tramway and Supply Co., Ltd.—The report for 1907 states that during the year ordinary and 6 per cent. preference shares were issued, bringing up the total issued share capital to £377,001. 25,000 ordinary shares were subscribed for at a premium of £1 per share, and the premium received, £25,000, has been set against the formation expenses, underwriting and brokerage and costs of share issues, reducing the balance on account of these expenses to £2,606. Difficulties have been experienced with the machinery, especially the two turbines, causing a delay of several months, and consequent prejudice to the company. It is only recently that these difficulties have been finally overcome and the company placed in a position to supply a continuous 24-hours' service. The machinery is now working satisfactorily. The electric tramway is completed and running. The receipts are very satisfactory and show steady improvement. Out of the amount available, £9,439, the preference dividend absorbs £9,000, and £439 is carried forward.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended March 27th, 1908, were 407,925, compared with 305,049 units in the corresponding four weeks of 1907.

The directors recommend a further dividend of 4¾ per cent., making 8 per cent. for 1907.

Russia.—La Société de l'Electricité du Midi de la Russie reports a profit of £12,328 for the last financial year, out of which a dividend of 7 fr. per share is being declared.

Belgium.—La Société des Accumulateurs Tudor, of Brussels, reports a profit of £5,767 for the last financial year.

MARKET QUOTATIONS.

Wednesday, May 13th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	38/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal)	per ton	£33 10	..
a	,, ,,	per ton	£30	..
a	Bleaching powder	per ton	£5 10	..
a	Bisulphide of Carbon	per ton	£18	..
a	Borax	per ton	£16	..
a	Copper Sulphate	per ton	£24	..
a	Lead, Nitrate	per ton	£28	..
a	,, White Sugar	per ton	£27	..
a	,, Peroxide	per ton	£39	..
a	Methylated Spirit	per gal.	2/6	..
a	Potassium Bichromate, in casks	per lb.	8½d.	..
a	Potash, Caustic (75/80 %)	per ton	£30	..
a	,, Chlorate	per lb.	9½d.	..
a	,, Perchlorate	per lb.	9d.	..
a	Potassium Cyanide	per lb.	7d.	..
a	Shellac	per cwt.	100/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %)	per ton	£10 15	..
a	,, Chlorate	per lb.	8½d.	..
a	,, Crystals	per ton	£8 5	..
a	Sodium Bichromate, casks	per lb.	8d.	..
a	,, Cyanide (basis 100 %)	per lb.	7d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots	per ton	£87	£19 5 dec.
b	,, Wire, in ton lots	per ton	£186	£4 dec.
b	,, Sheet, in ton lots	per ton	£134	£4 dec.
u	Babbitt's metal ingots	per ton	£50 to £130	..
c	Brass (rolled metal 2' to 12') basis	per lb.	7¼d.	¼d. dec.
c	,, Tube (brazed)	per lb.	8¼d.	¼d. dec.
c	,, ,, (solid drawn)	per lb.	7¼d.	¼d. dec.
c	,, Wire, basis	per lb.	6¾d.	¼d. inc.
c	Copper Tubes (brazed)	per lb.	9½d.	¼d. dec.
c	,, ,, (solid drawn)	per lb.	9¼d.	¼d. dec.
g	Copper Bars (best selected)	per ton	£78	£2 dec.
g	Copper Sheet	per ton	£74	£2 dec.
g	,, Rod	per ton	£73	£2 dec.
c	,, (Electrolytic) Bars	per ton	£59 10	10/- dec.
c	,, ,, Sheets	per ton	£76	£1 dec.
c	,, ,, Rod	per ton	£64	£1 dec.
c	,, ,, H.C. Wire	per lb.	7¾d.	..
f	Ebonite Rod	per lb.	3/8	..
f	,, Sheet	per lb	3/-	..
n	German Silver Wire	per lb.	1/6½	½d. dec.
h	Gutta-percha, fine	per lb.	5/6 to 6/6	..
h	India-rubber, Para fine	per lb.	3/8½	2½d. inc.
i	Iron Pig (Cleveland warrants)	per ton	..	..
l	,, Wire, galv. No. 8, P.O. qual.	per ton	£14 5	..
g	Lead, English Ingot	per ton	£13 5 to £13 10	2/6 inc.
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£8 2 6	2/6 dec.
d	Mica (in original cases) small	per lb.	6d. to 1/-	..
d	,, ,, ,, medium	per lb.	2/6 to 4/-	..
d	,, ,, ,, large	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/1½	dec.
p	,, rolled bars & rods	per lb.	1/2 to 1/3	..
p	,, ,, strip & sheet	per lb.	1/2½ to 1/5	..
o	Platinum	per oz.	100/-	..
e	Silicium Bronze Wire	per lb.	9½d.	..
r	Steel, Magnet, in bars	per ton	£55	£5 dec.
g	Tin, Block (English)	per ton	£133 to £135	dec.
n	,, Wire, Nos. 1 to 16	per lb.	1/10	1d. dec.
p	White Anti-friction Metals— "White Ant" brand	per ton	£34 to £58	..
k	Zinc, Sh's (Vieille Montagne bnd.)	per ton	£25 10	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

Scottish Tramway Officials' Association. — On Friday, May 8th, the members of this Association met in the office of Mr Shepherd, the general manager of the Edinburgh cable cars. Mr. Dalrymple, general manager of the Corporation Tramways, Glasgow (President) was in the chair. A paper on "Third Party Risks" was read by Mr. F. Coutts, general manager of the Paisley District Tramways, and after a discussion on it, the party were entertained to lunch by Mr. Shepherd, and afterwards adjourned to the Edinburgh Exhibition.

Concert. — A concert was given on the 5th inst. in the Recreation Hall of the Paisley District Tramways Co. at Elderslie Depôt. During the interval Provost Eadie, of Paisley, presented the ambulance class with their certificates and badges, and also presented the prizes for billiards, after which Mr. F. Coutts, general manager, presented Dr. Westwood Fyfe, in the name of the ambulance class, with a handsome silver gong, as an appreciation of his services as lecturer and instructor for the season.

STOCKS AND SHARES.

Tuesday Evening.

FINANCIAL weather in the Stock Exchange continues to be quite as changeable as that outside. Investment stocks, led by Consols, are still pendant upon the news from India. A clearing of the outlook on the frontier caused the premier security to rally from its lowest point, but the growing evidence of slackness in general trade circles has not brought increased business to the Stock Exchange as yet.

When trade in the country falls off, the demand for cash accommodation is relaxed, money becomes cheaper, and floating capital, no longer employable to the best advantage in the owner's industry, should seek Stock Exchange channels for its use. Such is the theory. As to the practice at the present time, any member of the Stock Exchange could dilate upon that point in words more eloquent than could be printed here.

Electricity supply shares are beginning to feel the metallic-filament lamp pressure, and prices have given way here and there in cases of metropolitan companies. Charing Cross, City of London, Kensington and Knightsbridge and Metropolitan shares are all easier this week, the decline embracing the Preference as well as the Ordinary in the case of the last-named. London Electric Supply Preference are ⅛ lower, while Smithfield Markets have experienced a slump, falling to about half a sovereign. On the other hand, Chelsea are ⅛ better.

The proceedings before the House of Lords Committee on the London Electricity Bills are being watched with much attention. There was a good deal of quiet amusement at the Committee's anxiety to know what would happen if the Barking station were to be shelled by Anarchists, or, as one member remarked, another foreign power. It was politely suggested that in certain of the present stations, a little waking-up would be an excellent innovation.

Business was marked on Monday last in Edmundson's shares at 15s. The Debenture stock has lost 2 points of its recent rise. Urban Ordinary fell to the nominal figures of 1—2.

Central London Railway Preferred stock gained 3 per cent. at 88, but the Ordinary is a trifle lower, notwithstanding the opening this week of the Franco-British Exhibition. Metropolitan Consolidated firmed up after being weak, the inauguration of the Earl's Court Exhibition being used as a favourable factor. Districts are unmoved.

Activity in the traction department is largely centred upon the Mexico issues and others of the same group. Mexico Tramways Common stock changes hands freely in the neighbourhood of 89, and the 5 per cent. General Consolidated First Mortgage bonds are being dealt in on the bases of 88—88½. Rio de Janeiro Tramway 5 per cent. gold bonds at 83½ command a fair amount of speculative investment attention. The light and power issues of this division, however, are very quiet. Canadian General Electric shares at 90 are dull, though the price has been lower still.

River Plate Electricity Ordinary shares drooped to 17s. 6d., the dividend and report being out, which leaves "nothing to go for" until nearly a twelvemonth. This may explain why there has been a little selling from the Argentine Republic just lately.

Further falls have lowered the prices of British Electric Traction Preference shares, and the company's two debenture stocks. Anglo-Argentine Debenture stock came to market, tempted by the jump in the price a week ago. Other tramway descriptions are steady.

Anglo-American Telegraph Deferred furnished its market with a mild sensation by rising 15s., although the Preferred is a similar fraction lower. One reason advanced for the rise in the "A" stock declares the company to be doing extremely well out of the business arising from the activity in American Railroad shares. None of the other trans-Atlantic cable issues, however, are better.

The Eastern division is more than usually quiescent. All the reports lately published tell much the same tale of increased receipts being won at the expense of costs which grow at a still more rapid rate. There is evidently considerable need for expenditure to be cut down, wherever economy will not interfere with efficiency. Globe Telegraph and Trust Ordinary are 2s. 6d. lower, and the Preference lost twice this amount.

Spirited bidding for National Telephone Deferred stock raised the price by half a point; beyond this, the company's list is unaltered. American Telephone and Telegraph went back a couple of points.

Babcock & Wilcox Ordinary shares have fallen ½ upon the nervousness prevailing in regard to the labour outlook in the engineering trades generally. Vickers-Maxim shares fell to 31s. before recovering to 34s. 6d. Cromptons are a shade easier, and British Aluminiums are dull.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1904.	1905.	1906.	1907.	Closing Quotations May 5th.	Closing Quotations May 12th.	Business done week ended May 12th, 1908. Highest.	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2 — 3	2 — 3	..	..	..	Nil
143,800	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	5 %	5 %	5 %	84 — 87	84 — 87	..	..	..	5 14 11
$131,551,400	American Telephone & Telegraph, Cap. Stock	$100	7½%	7½%	8 %	8 %	120 —124	118 —122	..	..	—2	6 11 2
53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 13 0
622,600	Anglo-American Telegraph	Stock	2⅜%	3½%	3⅜%	3½%	55 — 58	55 — 58	..	..	..	6 0 8
3,188,700	Do. do. do. 6 % Pref.	Stock	5⅜%	6 %	6 %	6 %	99 —101	98½—101½	101½	99⅜	— ⅛	5 18 3
3,188,700	Do. do. do. Deferred	Stock	Nil	⅛%	1⅜%	1 %	13⅜— 14⅛	14⅛— 15	14⅛	14	+ ⅛	6 13 4
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	5 %	5 %	5 %	98½—101½	98½—101½	..	..	..	4 18 6
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	7 — 7⅛	7 — 7⅛	7⅛	..	..	5 6 8
2,300,459	Commercial Cable Sting. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	84 — 87	84 — 87	..	..	..	4 12 0
16,000	Cuba Telegraph	10	5 %	5 %	5 %	..	7⅛— 8⅛ xd	7⅛— 8⅛	7 13/16	7½	..	6 1 3
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	15½— 16½	16⅛— 16½	16⅛	..	..	5 19 5
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8¼— 8½	8¼— 8½	..	..	..	5 14 3
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 %	8 — 9	8 — 9	..	..	..	5 11 1
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99½—102½	99½—102½	100	..	..	3 15 8
60,710	Direct United States Cable	20	8½%	4½%	4½%	..	13⅜— 14	13⅜— 14	13½	13½	..	6 12 2
53,700	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99½—101½	99½—101½	..	..	..	4 8 8
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	131 —136	131 —136	134½	134	..	5 2 11
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	84 — 87	84 — 87	85½	..	..	4 0 6
1,896,706	Do. 4 % Mort. Deb. Stock. Red.	Stock	4 %	4 %	4 %	4 %	100 —102 xd	100 —102	..	..	..	3 18 5
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12 — 12	12 — 13½	13⅝	13⅛	— ⅛	5 3 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
286,800	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98½—100¼ xd	98¼—100¼	..	..	..	15 12 4
181,127	Globe Telegraph and Trust	10	5⅜%	5⅛%	5⅛%	..	9⅛— 10⅛	9⅛— 10⅛	10⅛	9 13/16	— ⅛	5 7 4
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	13⅜— 14½	13⅜— 14	13½	..	— ½	4 5 9
150,000	Great Northern Telegraph, of Copenhagen	10	24 %	24%	20 %	20 %	29 — 31	29 — 31	29½	..	..	6 9 0
24,300	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99½—101½	99¼—101½	..	..	..	4 8 8
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	..	53 — 56	53 — 56	58	..	..	6 13 11
$41,380,400	Mackay Companies Common	$100	1 %	2 %	3½%	4 %	58 — 63	58 — 63	..	..	..	5 11 1
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	62 — 66	62 — 66	..	..	..	6 1 3
384,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅜— ½	⅜— ½	8/9	8/-	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	4 %	5 %	6 %	6 %	1 5/16— 1 7/16 xd	1 5/16— 1 7/16	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	15/16— 1	15/16— 1	..	..	..	5 6 8
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	107⅛—109½	107⅛—109½	108⅜	108	..	5 9 7
3,341,425	Do. do. Def. Stock	100	5 %	5 %	5 %	6 %	108½—110½	109 —111	110½	109	+ ½	5 8 1
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10⅝— 12⅝	10⅜— 12⅜	..	..	..	4 16 0
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	5 %	5 %	10⅛— 12⅛	10⅛— 12⅛	10⅝	..	..	4 0 0
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5⅝	..	..	4 8 11
2,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	98⅛	98⅜	..	3 10 0
1,710,093	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101⅛—103½	101⅛—103½	103	102	..	3 17 4
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6¼%	7 %	7 %	8 %	1⅜— 1½	1⅜— 1½	27/6	..	..	6 6 8
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1⅜— 1½	1⅜— 1½	..	..	..	4 16 0
99,100	Do. do. do. 4 % Red. Deb. Stock	100	..	4 %	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	4 19 3
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7½— 8½	7½— 8½	7½	..	..	4 8 3
99,100	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	4½%	4½%	4½%	99 —102	99 —102	99	..	..	4 13 0
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	126 —129	126 —129	..	..	..	6 3 1
100,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6 — 6½	6 — 6½	..	..	..	4 15 3
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	4⅜— 5⅛	4⅜— 5⅛	..	..	..	2 17 1
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	2½%	..	1⅛— 1⅜	1⅛— 1⅜	..	..	..	3 18 10
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	98½—101½	98½—101½	98⅝	..	..	5 1 10
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	..	13½— 13⅝	13½— 13⅝	13 13/16	13 5/16	..	3 18 5
800,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	Nil
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅞— 1	⅞— 1	..	..	..	9 2 10
84,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	5 %	8 %	..	8½— 8¾	8½— 8¾	..	..	..	Nil
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	8½— 9	8½— 9	8¾	8½	..	4 16 2
80,000	D do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..	

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

320,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,097	5	8 %	8 %	8 %	..	7⅞— 8⅛	7⅞— 8⅛	7⅜	7⅛	..	4 18 6
260,007	Do. 6 % Cum. Prefs., 1 to 260,007	5	5⅜%	5⅜%	5⅜%	5⅜%	6⅛— 6⅜	6⅛— 6⅜	6⅜	6 3/32	..	4 6 3
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	136 —141	135 —140	..	..	—1	4 5 9
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock	100	5 %	5 %	5 %	5 %	104 —107	104 —107	..	..	..	4 6 8
380,000	Babcock & Wilcox, 1 to 380,000	1	20 %	20 %	20 %	20 %	3⅜— 3⅝	3⅜— 3⅝	75/7½	71/10½	— ⅛	5 6 8
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000	1	6 %	6 %	6 %	6 %	1 3/16— 1 5/16	1 3/16— 1 5/16	..	..	..	3 16 10
40,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	3¾— 3¾ xd	3¾— 3¾	70/-	65/-	— ½	9 13 1
40,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	4⅛— 4⅜ xd	4 — 4⅛	87/6	83/9	— ⅜	7 15 7
20,000	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	4⅛— 5⅛	4⅛— 5⅛	..	..	— ⅛	5 14 3
20,000	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	3¾— 4⅛	3¾— 4⅛	..	..	..	4 14 1
238,200	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 15 3
800,000	Do. do. 5½ % Loch Leven Debs.	100	..	..	5½%	5½%	97 —100	97 —100	..	..	..	5 10 0
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	8 %	129 —132 xd	129 —132	131	..	..	6 1 8
800,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	111 —115	111 —115	..	..	..	4 6 11
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	107 —111	107 —111	..	..	..	4 10 1
285,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	99 —102	99 —102	99⅜	..	..	4 8 8
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 2
133,301	British Electric Traction	10	6 %	3 %	Nil	Nil	1½— 1⅝	1½— 1⅝	..	..	..	Nil
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	3⅜— 4⅛	3⅜— 4⅛	78/9	76/3	— ⅛	14 10 10
1,448,653	Do. do. 5 % Perp. Deb. Stock	Stock	5 %	5 %	5 %	5 %	90 — 95	88 — 92	90	88½	—2½	5 8 8
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	69 — 73 xd	67 — 71	69	..	—2	6 14 4
100,000	British Insulated and Helsby Cables	5	8 %	8 %	10 %	..	6¾— 6⅞	6¾— 6⅞	..	..	..	7 10 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞— 6⅛	5⅞— 6⅛	..	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
212,000	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	4½%	93 — 98	93 — 98	..	..	..	4 11 10
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	Nil	½— ¾	½— ¾	10/7½	..	..	Nil
1,016,358	Do. do. 4 % Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	45 — 50	45 — 50	48	..	..	8 0 0
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	1/16— 1/8	1/16— 1/8	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	Nil	2½%	Nil	Nil	0— ⅛	0— ⅛	2/6	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	Nil	Nil	3/16— 5/16	3/16— 5/16	..	..	..	6 0 0
125,000	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	74 — 79	70 — 75	..	..	— 4	7 10 0
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	59 — 64	55 — 60	..	..	— 4	8 1 6
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	4 %	3 %	3 %	..	4⅜— 4⅞	4⅛— 4⅞	..	..	+ 1/32	5 17 1
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 17 1
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..	..	4 6 2
310,000	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	110 —116	110 —116	..	..	..	4 15 3
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	102 —106	102 —105	..	..	..	4 8 11
137,610	Calcutta Trams, 1 to 137,610	5	8 %	8 %	8 %	6 %	6 — 7	6 — 7	..	..	..	4 13 0
80,000	Do. 5 % Cum. Pref., Nos. 1 to 29,830	5	..	5 %	5 %	5 %	5 — 5⅜	5 — 5⅜	5½	5⅜	..	4 4 11
850,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	103 —106	103 —106	105	104	..	6 13 4
85,000	Callender's Cable Construction shares	5	12½%	15 %	15 %	..	10¾— 11¼	10¾— 11¼	..	..	..	4 5 11
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..	4 2 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106¼—108½	106¼—108½	..	..	..	Nil
491,232	Cape E Trams., 1 to 491,232	1	5 %	Nil	Nil	Nil	1/16— 1/8	1/16— 1/8	..	..	..	5 11 4
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	6 %	8 %	..	1 1/16— 1 1/8	1 1/16— 1 1/8	27/9	27/6	..	4 6 7
215,045	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	102½	..	..	3 17 11
1,998,610	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	3 %	75 — 77	74 — 77	75½	74 3/16	..	4 9 11
558,195	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	84 — 86	87 — 89	88	..	+3	4 10 2
558,195	Do. do. Def. do.	Stock	4 %	4 %	4 %	2 %	54 — 57	54 — 57	56	..	..	3 10 2
1,480,000	City and South London Railway	Stock	2½%	1½%	2½%	2½%	39 — 41	39 — 41	40½	39½	..	5 8 8

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

Continued on next page

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1904.	1905.	1906.	1907.	Closing Quotations May 5th.	Closing Quotations May 12th.	Business done week ended May 12th, 1908. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	*	1904.	1905.	1906.	1907.						
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	3	2½%	2½%	5 %	5 %	1⅝ — 1¾	1 15/16 — 1 13/16	89/6	31/3	— 1/16	8 6 8
260,000	Dick, Kerr & Co., 1 to 260,000	..	5 %	5 %	5 %	5 %	92 — 95	92 — 95	..	..	..	5 5 3
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	10 %	10 %	10 %	10 %	1¾ — 1⅞	1 15/16 — 1 13/16	..	..	..	7 5 5
282,580	Do. dc. 4½ % Deb. Stock	1	6 %	6 %	6 %	6 %	1 — 1¼	1 — 1¼	..	..	..	4 16 0
60,000	Dublin United Trams. (1896), 1 to 60,000	100	4½%	4½%	4½%	4½%	100 —103	100—103	..	..	..	4 7 5
59,287	Do. 6 % Pref. between 1 and 60,000	10	6 %	6%	6 %	6¼%	12½ — 13½	12½ — 13½	..	..	..	4 18 2
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 7 3
17,139	Do. "A" shares, 01—017,139	5	2½%	4½%	4½%	..	¾ — 1	¾ — 1	..	..	..	12 10 0
319,475	Do. 4 % Deb. Stock Red.	5	2½%	4½%	4½%	..	1⅝ — 2¼	1⅝ — 2¼	..	..	..	8 6 9
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	4 %	4 %	4 %	4 %	78 — 81	78 — 81	..	..	..	4 18 9
112,100	Electric Construction, 1 to 112,100	100	5 %	5 %	5 %	5 %	85 — 87	85 — 87	..	..	..	5 14 11
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	Nil	Nil	Nil	Nil	⅜ — ½	⅜ — ½	7/-	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	2	7 %	7 %	Nil	Nil	1½ — 1⅝	1½ — 1⅝	..	..	..	Nil
200,000	Do. do 4 % Mort Deb.	10	5 %	5 %	5 %	..	7½ — 8¼	7½ — 8¼	..	..	..	6 1 3
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	Stock	4 %	4 %	4 %	4 %	87 — 90	87 — 90	..	..	..	4 8 11
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	4 %	4 %	4 %	1%	⅜ — ½	⅜ — ½	..	..	..	3 6 8
80,000	Do. do. 5 % Mort. Debs.	10	7 %	7 %	7 %	..	10½ — 10¾	10¼ — 10½	..	..	..	6 10 8
40,000	Henley's (W. T.), Telegraph Works, Ord.	100	5 %	5 %	5 %	..	102 —103	102 —103	..	..	..	4 17 1
46,000	Do. do. 4½ % Pref.	5	15 %	15%	15 %	15%	10½ — 11½	10¼ — 11¼	..	..	..	8 13 10
150,000	Do. do. 4½ % Mort. Deb. Stock	5	4½%	4½%	4½%	4½%	4⅜ — 5⅜	4⅜ — 5⅜	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works.	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	..	..	..	4 3 4
37,500	†Liverpool Overhead Railway, Ord.	10	5 %	10%	10 %	..	15½ — 16½	15¼ — 16½	..	..	..	6 1 3
10,000	† Do. do. Pref., fully paid	10	1¼%	Nil	Nil	⅜%	1⅜ — 1½	1⅜ — 1½	..	..	..	Nil
600,070	London United Trams. (1901), 1 to 50,007	10	5 %	5 %	5 %	5 %	5⅜ — 6¼	5⅜ — 6¼	..	..	..	8 3 3
399,930	Do. do. 60,008 to 100,000	10	6 %	3 %	3 %	..	6¼ — 6¾	6¼ — 6¾	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	6 %	3 %	3 %	..	6¼ — 6¾	6¼ — 6¾	..	..	..	4 8 11
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	10	5 %	5 %	5 %	5 %	6⅝ — 7⅜	6⅝ — 7⅜	..	..	..	6 9 0
5,732,062	Metropolitan Consolidated	100	4 %	4 %	4 %	4 %	80 — 85	80 — 85	..	..	..	4 14 2
2,640,914	Do. Surplus Lands	100	3 %	2½%	1 %	1%	42 — 43	43 — 44	44	41⅞	+1	1 2 9
3,235,000	Do. District	100	2½%	2½%	2½%	2½%	66 — 68	66 — 68	67½	66½	..	4 0 11
314,016	Metropolitan Electric Trams., Defd.	100	Nil	Nil	Nil	Nil	11½ — 12½	11½ — 12½	12¼	11 13/16	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	Nil	Nil	Nil	..	3/16 — 5/16	1/16 — 1/8	1/-	..	..	Nil
350,000	Do. do. 4½ % Deb. Stock Red.	1	5 %	5 %	5 %	5 %	⅛ — ⅜	⅛ — ⅜	15/-	14/6	..	6 3 1
245,500	Potteries E. Tre.	100	4½%	4½%	4½%	4½%	94 — 97	94 — 97	95½	..	..	4 12 9
245,500	Do. 5 % Cum. Pref.	1	4 %	4 %	4 %	4 %	¼ — ⅜	¼ — ⅜	..	..	..	8 0 0
245,500	Do. 4½ % Deb. Stock	1	5 %	5 %	5 %	5 %	⅜ — ½	⅜ — ½	..	..	..	6 13 4
37,350	Telegraph Construction and Maintenance	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	97¼	96	..	4 18 9
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	12	15 %	15 %	15 %	17½%	30 — 32	29 — 31	31½	30	—1	7 0 0
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	..	5 %	5 %	5 %	5 %	36 — 40	36 — 40	..	..	..	12 10 0
66,666	Do. 6 % C.P., 80,001 to 80,000 & 125,001 to 141,666	1	Nil	Nil	Nil	10 %	⅛ — 1¼	⅜ — 1¼	..	..	— ⅛	8 0 0
46,404	Do. 4 % 1st Mort. Deb. Stock	5	Nil	Nil	..	6 %	3⅛ — 3¼	3⅛ — 3¼	68/1½	..	..	7 10 0
		100	4 %	4 %	4 %	4 %	72 — 77	72 — 77	..	..	..	5 1 0

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P,. 1 to 15,000	5	5½%	5½%	5½%	5½%	4⅜ — 5	4⅛ — 5	..	..	..	5 10 0
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	94 — 97 xd	94 — 97	..	..	..	4 10 11
30,131	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10%	10 %	7 — 8	7 — 8	7¾	..	..	6 1 3
9,869	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	6⅞ — 7⅜	6⅞ — 7⅜	..	..	..	4 10 4
836,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	98 —101	98 — 101	..	..	..	3 19 3
80,000	Charing Cross and Strand Electricity Supply	5	8 %	5 %	5 %	5 %	3⅝ — 4⅛	3⅛ — 3⅞	72/6	..	— ⅜	6 13 4
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅛ — 4⅜	4⅛ — 4⅜	83/9	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞ — 4⅛	3⅞ — 4⅛	..	..	..	5 5 11
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	97⅛	..	..	4 0 10
49,436	Chelsea Electricity Supply, Ord.	5	6 %	6 %	4½%	4½%	3 — 3¼	3⅛ — 3⅜	..	..	+ ⅛	6 4 2
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	9½ — 10½	9¼ — 10¼	9¾	9½	— ½	5 17 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	..	..	..	4 12 4
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 11⅝) all pd.	..	5 %	5 %	5 %	5 %	123 —126	124 —127	126	..	+1	3 18 9
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —104	102 —105	..	..	+1	4 5 9
40,000	County of Durham Electrical Power, Ord.	5	£3 7 0	4 %	4 %	4 %	3 — 3⅜	3 — 3⅜	..	..	..	5 6 8
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	5 5 3
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4½%	5 %	5 %	5 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	6 1 6
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅜ — 11¼	10⅜ — 11¼	10⅛	..	..	5 6 8
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	109½	103	..	4 1 10
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	96 — 99 xd	96 — 99	97½	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	4 %	Nil	..	⅜ — ⅝	⅜ — ⅝	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	8 %	..	¾ — 1	¾ — 1	15/-	..	..	12 0 1
433,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	55 — 60	53 — 58	57	54	—2	7 18 2
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ — 5¼	4⅜ — 5¼	..	..	..	5 4 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	5 %	5 %	5 %	5 — 5⅜	5 — 5⅜	..	..	..	4 10 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
15,000	Hove, 1 to 15,000	5	8½%	9 %	9 %	8½%	6¼ — 6⅝	6¼ — 6⅝	..	..	..	6 13 4
21,000	Kensington and Knightsbridge Electric Ord.	5	12 %	10 %	10 %	10 %	7⅝ — 8⅛	7⅝ — 8⅛	..	..	— ¼	5 17 8
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
10,000	London Electric Supply Corporation, Limited, Ord.	3	3 %	4 %	4 %	2½%	1 — 1⅛	1 — 1⅛	..	..	..	5 0 0
70,000	Do. do. do 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅜ — 5	4⅜ — 4⅝	..	..	— ⅛	6 3 1
74,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4½%	4½%	90 — 93	90 — 93	..	..	..	4 16 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	10 %	8 %	6¼%	4⅜ — 5⅛	4⅜ — 4⅝	87/6	..	— ⅛	6 16 9
75,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 5¼	4⅜ — 5	..	..	— ¼	4 10 0
230,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	107 —111	107 —111	..	..	..	4 1 1
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	85 — 90	85 — 90	..	..	..	3 17 9
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 5 10
87,500	Newcastle-on-Tyne, 1 to 87,500.	5	8 %	8 %	8 %	8 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	— ⅛	6 13 4
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5 7/8	5⅜	..	4 10 11
10,852	Notting Hill Electric Lighting	10	7 %	7½%	7½%	7½%	11½ — 12½	11½ — 12½	..	..	..	5 12 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	5⅝ — 6⅜	5⅝ — 6⅜	..	..	..	5 9 10
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	94 — 98	94 — 98	..	..	..	4 1 8
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	12½%	10 %	10 %	7½ — 8¼	7¼ — 8¼	..	..	..	6 3 1
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6¼ — 7	6¼ — 7	..	..	..	5 0 0
160,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3 %	3½%	3½%	85 — 90	85 — 90	86	..	..	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	Nil	Nil	⅛ — 1¼	¼ — ¾	..	..	— ½	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	70 — 74	70 — 74	..	..	..	5 8 1
65,000	South London Electricity Supply, Ord.	5	4 %	4 %	3 %	4 %	2⅝ — 2⅞	2⅝ — 2⅞	..	..	..	6 19 2
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	2½%	2½%	2½%	⅞ — 1	⅞ — 1	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	— ⅛	5 6 8
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 8
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅜ — 2½	1 — 2	..	..	— ¼	12 10 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅜ — 2½	1⅜ — 2½	..	..	..	11 1 10
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	87 — 90	87 — 90	..	..	..	5 0 0
110,000	Westminster Electric Supply, Ord.	5	14 %	18 %	12 %	10 %	7⅛ — 8	7⅛ — 8	7⅛	..	..	6 5 0
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	4½%	4½%	4⅜ — 5¼	4⅜ — 5¼	5 3/32	96/3	..	4 5 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. § Interim Dividend.

Bank rate of Discount 3 per cent., March 19th, 1908.

ELECTRICITY IN MINES: BREAKDOWNS OF MACHINERY, AND THE CAUSES OF ACCIDENTS.

By FACTOR OF SAFETY.

Coal-cutting machines are in many cases the causes of accidents occurring through the use of electricity in mines, and the mines electrician is not always to blame. Many mines have, since the new Mining Regulations were passed, employed good, sound practical men with theoretical knowledge to look after the electrical plant. If these men did not try to conform to the Home Office Regulations to the best of their ability, to keep themselves out of trouble, I should say they would be very foolish. But the manager is the responsible person, and that is as it ought to be. The reason I will point out later.

Are the men who drive an electrical coal-cutter usually competent for the work they are set to do? In many cases I say, No; they may be very good miners, and so on, but the machine itself they know nothing about. They can start and stop it, put fuses in the gate-end switch, and fix trailing cable; and then their knowledge ends. Is this as it ought to be? I think the driver of a coal-cutter should be as familiar with his machine as an engine driver with his steam engine. When a coal-cutter driver has to send for the mines electrician to clean the commutator on the motor, to stop sparking and tighten up a loose connection, little matters he could easily attend to himself, can one wonder at accidents? The machine might be in good order at the time when the mines electrician inspected it. But as a coal-cutter is subject to very heavy vibration, &c., anything may happen in the course of a few hours, especially when the driver has no knowledge of his machine; and again, when the coal-cutter gets fast in the cut, how can the mines electrician know that they have been employing a double strength of fuse to get them out of their difficulties, with the deputy's sanction, and sometimes the under-manager's? What is the good of the mines electrician's supplying them with a suitable stamped fuse to act as a safeguard to the machine, if they flatly disobey his instructions when he is not there? When these matters are attended to, some of the accidents through coal-cutters will cease.

Then, again, are coal-cutting machines all that they ought to be? I should say there is room for improvement. In the first place, I think there should not be any exposed cables belonging to the motors on the coal-cutters, as these are liable to get damaged through falling material earthing some of the cables, and the result is that the men working the machine get an electric shock. In some cases it is slight, in others dangerous, depending upon the wet or dry condition of the place where the machine is at work. All coal-cutters should have a very small window of extra strong glass fixed in such a position that one can see if any sparking is taking place on the commutator, and if to any dangerous extent. Some coal-cutters are without this, and if anything happens to the motor armature, the first intimation one gets sometimes is a nasty shock. The manager buys this machinery; he is the responsible person. The mines electrician takes charge of it, and tries to keep it in order as far as he can. Sometimes he will try to advise the manager, who has a personal interview with the maker of the machine, and the electrician is called up to the office also. This is what usually takes place:—

Manager to the maker: "Our electrician here says he does not like the construction of the electrical parts of the last new coal-cutter you supplied us with."

Maker to electrician (with a dark frown): "What is wrong with our coal-cutter?"

Electrician: "Well, I should like a small window above the commutator; also, I think, the starting barrel is not very strongly made, and the resistances are very weak and liable to earth on the iron spindles supporting them, and the bushings where the cables pass through into the motor are not flame-tight."

Maker to manager (ignoring electrician): "I am sorry, Mr. So-and-So, your man here does not appear to know anything about electrical coal-cutters. We have built your machine according to our standard practice, and many years' experience, and it is the very first complaint we have had."

Then the manager says: "You hear what the maker says, and as he is the maker of the machine he ought to know. You may go."

Sometimes the manager will ask the mines electrician to specify to the makers the kind of motor he requires for a certain purpose, but these cases are very rare. Why will some makers supply a flame-tight motor, with inspection doors beautifully lined with red felt, all connections flame-tight—and a nice round hole through the bottom of the motor case, the size of a shilling, to let the oil run out that creeps along the shaft from the bearings, and drops in the motor-box bottom? I should have thought a better way would be to arrange a small channel in the bottom of the motor box provided with a suitable drain cock to let the oil off when the motor is standing. I am referring to some motors that I have seen. We have some manufacturers who turn out a good article, but it is the shoddy kind that is the source of danger—the kind of motor that inspires one with a false sense of security, and the maker who thinks one class of goods will suit all mining conditions.

Now, with reference to the dangers from the trailing cables, are not the miners themselves in many cases to blame for their carelessness? I should say they were. One hears of the trailing cable always fusing. Take a coal face, for instance, 80 or 90 yards in length, with a great number of miners working on it, all using picks and shovels. The coal-cutter is working at the same time; the cable is supported on the props down the face, and sometimes a miner, swinging his pick, will drive it straight through the cable with a backward blow of his pick. Has the man sufficient room to work in, or has the trailing cable been tied up too near him? Sometimes the miners will knock the trailing cable down by accident, and will not trouble to pick it up again. Another workman will throw down a wood chopper he has been using, usually on top of the cable. Result: the cable is cut through and short-circuited, and a heavy flash occurs.

In other cases the trailing cable will cross a main gateway, where a workman is taking some bars out. He takes the trailing cable down, but is called away for a few minutes, and leaves the cable on the ground. He thinks he will be back in a few minutes, and it does not matter. During the time he is away, a pony driver comes along with a couple of full corves or tubs; if it is a level road he is generally behind them. Sometimes the horse passes over without doing any damage, but the tubs, when they cross over the cable, cut it in two. Result: another short-circuit and a heavy flash. At another time, perhaps, a miner is bringing a full tub along; the same thing happens; if it be an iron tub and a wet place, he gets a severe shock. Who is to blame for this? Not the mines electrician.

I have known short-circuits occur on the face, due to the kinking of the trailing cable. This generally happens when using a twin trailing cable. After using the cable it ought to be coiled on a suitable drum, and then run out again when required for use. This keeps all kinks out of it, and lessens the danger of short-circuits from that cause.

With reference to the main cables themselves, in many mines one will find cables run up the side of the main gigs or self-acting inclines, sometimes as steep as 1 in 5. If so, when a train of corves breaks away from some cause or other, they run back down the incline at express speed, knocking out props and bars, and ploughing up the rails and sleepers; of course the cables have to come down with the rest. It does not matter whether they are armoured or not, they suffer a considerable amount of damage, resulting, in many cases, in short-circuits and heavy flashes This is the kind of thing you have to deal with in mines.

Regarding the types of gate switches in use, I may say there are some very good ones, but still there is room for much improvement. Of all the types, I consider the best for mining use are those with a locking arrangement, such that one cannot switch the current on to the trailing cables while the box is open, and it must be closed before doing so; also while it is open one cannot possibly touch any live metal, as all the live parts are covered over with asbestos slate, with slots to allow plungers to come into contact with

the live metal by the action of switching on. But in double-pole switch and fuse boxes the mistake is very often made of not having ample insulating material between the poles and the box sides. Sometimes, if both fuses blow together, an arc is struck on to the side of the box which causes the main cable fuses to blow, besides doing considerable damage to the gate switch.

Of course, enclosed fuses could be used, but it would be a very expensive item, considering that sometimes a dozen or more fuses will be blown during the day by the coal-cutter. The kind of fuses I have had the best results with, are those with porcelain handles and an asbestos tube running through to damp the fuse, and protect the handle from fracture through the fuse blowing.

The kind of box I have not such a good opinion of, is the one with no protection to the live metal, and which can be switched on and off with the box open; also bare fuse wire staring one in the face when the box is open. This kind of box I consider dangerous, because I have known cases when, the fuses have been blown through the coal-cutter being fast, the man in charge of the machine has sent one of his men to put the fuses in. The man turns the switch off, opens the box, removes the old fuses, replaces with new, forgets himself, and turns the switch on without first closing the door. As it happens, the man in charge of the machine is in a hurry to get the cut through and get home. He says to some of his other men, "I wonder if So-and-So has got the fuses in; I will just try the machine and see." He does so; the machine is still fast, and blows the fuses right in the man's face. This is how accidents occur; who is to blame? Charge-man; deputy; man who puts fuses in; maker of box; or mines electrician? Why does the mines electrician have such a switch box?

But why does the manager buy such a box?—The same old tale.—"We have a great number at work, and we have had no complaints." All dangerous parts of electrical apparatus should be as well guarded as the small flame of a safety lamp. Then, again, you sometimes hear that if there is sufficient gas, &c., to form an explosive mixture, it is not safe for the men to work, let alone coal-cutters. It is a very good thing to keep the mine well and efficiently ventilated; but it is always very wise to bear in mind that it is generally the unforeseen that happens.

In conclusion, I may say that we have some very good, right-minded, honest manufacturers, who are very willing to do their best for you; but there are some who might do better.

THE TEACHING OF EVENING STUDENTS IN ENGINEERING.

By W. J. CRAWFORD, B.Sc.

A LONG experience has shown the writer that successfully to teach artisans and others engaged in engineering, requires most careful consideration of every detail of their conditions of life and employment. Simply setting forth to give an hour's instruction in class, in, say, Practical Mathematics, with the soulful intention of doing one's best during that hour, and then leaving the scene till the next lesson is due, is not by any means sufficient. The teacher must be a good teacher undoubtedly, but there is much more than the actual teaching in front of and behind the hour's tuition in class.

The students under his charge will comprise those who work by day in the fitting shop, the turning shop, the drawing office, the Corporation power station, the electrical department of a steel works, the surface plant at a pit-head. They will include the collier down the mine, the lad who has just left school and who has the ambition of the inexperienced for his coming profession, the lad who is at the secondary school and who thinks he knows more than the mere artisan, the worker in the locomotive shop, the engine tenter, and dozens of others in various branches of engineering, some only entering upon it, indeed, but whose dearest longing is to become full-fledged members, and others some distance along the way.

The teacher must learn to use sympathy, and he must have a large amount of inborn tact. He must have organising abilities, or must develop them so as to mould into a not too ungainly whole all these divergent and variable elements. In fact, the actual teaching work comes last (of course, not least); the groundwork of sympathy, inquiry and advice comes first and prepares the way for suitable development when the seed is planted.

Let us analyse the methods of a teacher who desires the best results for the students under his charge.

Qualifications:—The teacher of engineering and allied subjects must have an all-round practical training; that is, he must have been through the shops as an apprentice; he should know intimately the use of engineering tools, he should have used the file and chisel, should have worked at the lathe, the fitter's bench, the brass shops, the electrical station; he should be acquainted with the interior of a boiler from experience, he should have had his fingers trapped in a belt or his overalls torn at the emery wheel; in fact, he should have been through what many of his students are at the moment undergoing.

Without this preliminary training, a teacher of engineering subjects can never hope for any real success; for, if he aspire to teach, say, machine drawing, he will be tripped up everywhere by inconvenient questions on the part of his pupils. His training, therefore, in this respect should be of the sound all-round order.

But this practical work alone will not give the success which it is the object of the teacher to attain. In addition, he must have high theoretical training, obtained preferably at one of our engineering universities, where he should have taken a three or four years' course and emerged with his engineering degree. This University training, combined with his practical knowledge, will give him a firm foundation to work upon.

The respect of his students is the first characteristic of a successful teacher. They must feel for certain that he knows a lot more than they themselves do; that no glib-tongued youth of the know-all order can catch him unawares.

At the same time, if a teacher have several hundred students under him, and these be engaged at nearly every branch of engineering and allied work, it is practically impossible for him to have had practical experience of every detail of all their work. Many a teacher fails at this point. He tries to cover his ignorance with a veneer of superficial explanation, which soon, in spite of its pretty surface, gets rubbed off as the student probes a little. Then that particular student's respect is undermined; and as this sort of thing is catching, failure is practically certain from that moment.

Far better is it to acknowledge oneself human; to own up, in front of a large class it may be, that one has had no experience of the particular point raised, but, at the same time, to intimate that full particulars would be looked upon as an obligation. Ask the student to write a full account of the process, as it appears to be of great interest; when, in all probability, the thing that is puzzling him will be elucidated with the help of his teacher's all-round training and scientific accomplishments.

A student likes to be asked to do things for his teacher, and especially does he like to feel that he has a personal matter of this sort to enter into. He is aware that his teacher knows many more things than he himself does; this particular one, in which he is master, puts him in the rôle of teacher to his teacher for the moment.

If the student knows surely that his teacher will never claim the possession of knowledge he does not possess, but will own up to it and ask for information even in class front, then his respect for that teacher becomes very great indeed.

The teacher should do his best to become more or less personally acquainted with each student; that is, he should try to know a little about him beyond what he sees in class. The obtaining of such a knowledge is not difficult. A quiet little chat here and there, an inquiry as to his hours of work, an opinion that he must not overdo the thing and study too hard, a little sympathy when the employer makes him work a lot of overtime, a talk as to his prospects in the years to come, and so on; for all this opportunity comes often, in class and out, and the result is marvellous. The

pupil feels that his teacher takes a real interest in him and does not regard him as a mere automaton, just a unit in the hundreds about him. It breeds a spirit of "camaraderie" and more. The writer has no firmer friends than some of his advanced students, who have been with him for years, who do their utmost by regular attendance and attention to make his classes a success, and who, by their example, influence the younger and in-coming students in the best of ways.

The backbone of an engineering class lies in the student who is of humble birth, who has had only the education the elementary schools can give him, who works nine hours a day at the bench, but who is most decidedly anxious to get on in the world. Three or four students of this type per class will set the form of the whole, and will even appreciably raise the level of the school. Hence it is the teacher's duty to have complete command of this student. His exact employment should be known, what he does practically each hour of the day, how his shifts run, how he employs his spare time, &c. The teacher should invite him occasionally to his private house, to discuss with him any examinations he has entered for, and to give him advice as to what to particularly study to have the greatest chances of success. When the examination is over, the teacher must inquire carefully as to the result, to congratulate in the case of success, or to commiserate in the event of failure. But very seldom, indeed, is success absent with this type of student, for although by no means brilliant, he sticks to his work like a leech. He is a very important young man. He sets the tone. He talks with his mates in the workshop, compares notes, prepares questions for his teacher, and does generally an inestimable amount of good.

An opposite type is the student who has been attending a secondary school, a grammar school, a boy's high school, &c. This one is as a rule of the good-comrade, superior, super-educated type, inclined to look upon things with a rather light eye. He usually knows no engineering worth mentioning, but has something of mathematics about him. The best plan is to shift him into the advanced mathematics classes, and to show him how little he really knows of the subject. Get him to solve a cubic equation by means of squared paper, touch him up with a little calculus, and lo and behold, he climbs down. The rest is easy. If he has good stuff in him, he will commence at the beginning, and do exactly what he is told; if he is wanting in solidity, it is best to get him out of the class at once.

Personally, the writer has had very little trouble with this kind of student, and it is only fair to add that when he proves amenable to reason, as usually happens, he eventually turns out a credit and honour to the school.

The most unsatisfactory student is the one who is compelled to attend by his parents, when he would very much prefer to be walking the streets, playing the sweetheart or embryo young man about town. Nothing can really ever be made of him; he is one of nature's labourers—a "boss" he never can be. Perhaps it is just as well, for the world would never continue to revolve so sweetly were we all imbued with the laudable desire to "get on." He will always be subservient to the will and brains of another; he has no desire and cares not a jot to climb the ladder.

It seems to the writer that those who advocate so strenuously compulsory evening education would do well to take a technical teacher's place for a few weeks. They would soon find that the compulsory and unwilling student is a nuisance to the teacher and a curse to himself. He lowers the *morale* of the rest. He is idle and restless, usually glib of tongue where there is a chance of evading duty, and a continual source of trouble and worry all round.

Teaching.—The technical teacher has always to remember that his class is made up of many divergent elements, new students and old, students engaged in many different occupations, some with a fair previous education, a few with a good one, but most in this respect indifferently equipped. It should be his aim so to organise the classes that he keeps the standard of previous knowledge as even as possible. One or two badly equipped students will greatly damage the whole class. The results are not so bad if the reverse holds and there are a few head and shoulders above the rest, but the working of the class is not then efficient. The teacher may be inclined to go too fast, considering the quick answers of the favoured ones as more or less pertaining to the body of the students and holding good for them all. The more even he can get his class as regards previous training the more efficient will his teaching become, other things being anything like equal.

A good plan is to work more or less by "example," and to question the individuals of the class by rotation. This keeps the attention strained. At the same time, it must be noted that some students are very shy and dread making wrong answers. But if the teacher use tact, and show plainly that he is far from trying to make a fool of anybody, but, on the contrary, his only object is to make each point understood and to help along the backward ones, then it is quite wonderful to see how confidence returns and how shyness gives place to cordial frankness. For instance, if the class is told at the conclusion of a problem that the teacher will be glad to hear of any point in the proof that is not quite clear, there will probably be many questions to answer; and the type of question soon shows a teacher, if he does not know already, the points upon which most students find difficulties.

The writer does not intend to go fully into the teaching of separate subjects, but perhaps a few remarks upon the subject of practical mathematics may not be out of place.

Practical Mathematics.—This subject is not very old. It consists more or less in giving the practice of mathematics without the theory; a very laudable object no doubt as a time saver, but it is being shockingly overdone. Practical mathematicians are springing up by the score from all sorts of out-of-the-way corners. People who know a little arithmetic, less algebra and no trigonometry, potter about with specific gravity bottles, with balances, with little wooden cylinders, &c., and, forsooth, are teaching practical mathematics. The enthusiasm of these teaching votaries for the subject is astonishing—it is so easy now to be a mathematician; not long ago it was a more difficult matter. It seems to the writer of this that it is high time a limit was reached.

Contracted Methods in Multiplication and Division.—The writer has found from experience that for engineering students these contractions are useless. In the first place, students have great difficulty in remembering them, and again, as logarithms and the slide rule are in regular use, their advantage is not apparent. In practically no case has the writer found a student with any facility in their application.

Squared-Paper Work.—There is some danger of this subject being worked to death. No one realises its importance more than the writer, but there is a proper place for it, and its place is surely *after* a working knowledge of the simple equation. Yet how often can a student gliby record squared-paper results, but cannot work with facility where an unknown quantity is concerned. The consequence of the latter fact is that to solve various simple problems in mechanics, steam, &c., many awkward and cumbrous devices have to be employed. The writer has for several years given instructions that all students must be taught a working knowledge of the simple equation right at the beginning.

The teacher should impress on his students the fact that an adequate mathematical knowledge will wonderfully advance and facilitate their study of engineering; that mathematics are the tools of the theoretical side of their work. Try to get up enthusiasm in the mathematics classes. Make the study interesting by taking many practical examples out of the engineering workshop.

The teacher will find that, other things being equal, the success of his teaching of engineering subjects will vary directly with the success of his mathematical teaching.

As regards home work, the writer finds it a good plan to apportion the same number of marks whether the answer be right or wrong, so long as the student has shown that he has honestly endeavoured to solve the problem.

As before indicated, the teacher should lose no opportunity of endeavouring to make the whole of his students feel, whatever their various branches of study, that they are members of one family, the great family of scientists and engineers. Anything that will conduce to this spirit of comradeship will greatly help on the teaching. It was for this purpose that the writer inaugurated a few years ago an Engineering Society for Evening Technical Students. Such

societies are common enough in the Universities, &c., but are very rare in technical institutes and colleges where evening work is mostly done. A short account, therefore, of the working of such a society may not be out of place. It is to be remembered that the society is for evening students only, and is entirely run by them.

The membership card contains the following rules :—

1. The objects of this Society are to promote the educational and professional interests of its members, and to supplement the theoretical training undergone by them in the various science classes by—

(*a*) Promoting visits to the various large engineering works in this neighbourhood, so as to enable the members to gain a varied insight into the practical side of engineering.

(*b*) Soliciting the services of local engineers and other gentlemen who may be willing to lecture before the members of the Society in the direction indicated.

2. The annual subscription is 1s., which entitles the member to all the privileges arising from the lectures and visits which may be arranged. Should the funds of the Society require it, a levy sufficient to meet expenses will be made upon the members, in addition to the annual subscription.

3. Any person wishing to become a member of this Society must make his application through two other members, proposer and seconder, to the Committee for their approval.

4. All members visiting works with the Society must produce the membership card when requested to do so by any member of the Committee deputed for the purpose of inspecting them. Any member being without his membership card must be vouched for by at least two other members before he will be allowed to enter the works or the meeting room.

5. Members of this Society are strongly advised against approaching too near machinery in motion when visiting works, and they should also implicitly follow the directions of the guides and of cautions exhibited in the works. They must also ascertain the wishes of the guides before opening doors that are closed or before venturing into places where it may be supposed that extra precaution is necessary.

6. Any member of the Society who wishes to invite a friend to attend one of the lectures, must give in his name, together with that of the person whom he desires shall attend the lecture, to the secretary not less than a week before the date on which the lecture is to take place.

7. Any person suspected of visiting works with the Society for any purpose other than as set down in these rules, shall be quietly and privately asked to withdraw from the Society.

8. The Committee appeals to every visitor connected with the Engineering Society to return the generosity of those manufacturers who allow inspection of their works by—

(*a*) Exercising the greatest care and caution with regard to machinery and plant.

(*b*) Treating the opportunities of inspection as a great privilege ; and

(*c*) Carefully refraining from acting or speaking in any way which may be considered offensive to the managers or workmen.

9. No person is eligible for membership of this Society, unless—

(*a*) He is a past or present student of the various X—— (or elsewhere) evening technical classes.

(*b*) He has been enrolled as a member in previous years.

10. All officials of the Engineering Society must be registered and fee-paying students of the X—— technical institute or preparatory evening classes, during the time they are in office.

Some points to be noticed are :—The fee is only 1s., so as not to inconvenience even the poorest student. No additional levy has yet been made, a balance being always in hand at the end of the session. The average membership is 150. The committee (elected annually) consists of students and teacher.

The visits are made on Saturday afternoons, and the lectures take place on Saturday evenings. An annual social and dance is held at Christmas.

The Society proved a success from its first meeting ; the students took to it with avidity, and there is always great competition to get on the Committee. As many as ninety members have been down a colliery pit on one afternoon. Occasionally "away" visits are made from 20 to 100 miles, but the whole of the Saturday is then taken up, and excursion railway bookings are taken advantage of.

This Society has done an enormous amount of good to the students. Not only have the lectures and visits been most beneficial, but the spirit of mutual goodwill has permeated all the classes, because the students have got to know one another, have compared notes with one another, and have realised how the various branches of study, seemingly detached, are really only parts of the whole.

PROCEEDINGS OF INSTITUTIONS.

The Manufacture of Electrical Condensers.

By G. F. Mansbridge, Member.

(Abstract of paper read before the Institution of Electrical Engineers, *London, May 7th,* 1908.*)*

Owing to the great development of the telephone service of the world, in which condensers play an important *rôle*, the aggregate output of condensers in Europe and America during 1907 is estimated at the once-inconceivable capacity of 5 farads.

The manufacturing costs have been so greatly reduced that condensers equal in quality to those produced ten years ago can now be purchased at approximately one-tenth the price, and this reduction in cost has brought about a further increase in the demand, since it now pays to employ condensers for many services from which they were previously shut out by their high cost.

The numerical data quoted must be considered as representing the carefully digested results of workshop tests made in the ordinary course on large batches of condensers; their accuracy is sufficiently close for all ordinary purposes. Many of the data are gleaned from the records of the Post Office factory at Mount Pleasant, Clerkenwell, E.C.

The various types of condensers fall naturally into four chief classes, namely—Mica; glass; paper or other fibrous material impregnated with wax, resin, oil, &c. ; and electrolytic cells.

On account of the very high cost of mica sheet suitable for the work, condensers of this form are but little used. When well made they retain their capacity and insulation better than those made of paper, and have a higher dielectric strength for the same thickness, but the cost per microfarad is approximately ten times greater than that of paper condensers. The inductive capacity of mica is about twice that of paraffined paper. The size of the sheets is limited to about 4 in. by 3 in., and a good working thickness is 0·0015 to 0·002 in. For standards mica is unrivalled. In standards the chief desiderata are :—

1. Constant capacity with efflux of time.
2. Constant capacity with varying temperature.
3. High insulation and low absorption.

To obtain (1) it is necessary that the mica and tinfoil sheets be perfectly flat and free from inequalities, so that they will build up under pressure into a solid mass without flexure or mechanical strain; and that in assembling the sheets all air bubbles be excluded.

To obtain (2) advantage is taken of the fact discovered by Dr. Alexander Muirhead that the mica sheets have a positive temperature coefficient if coated with shellac, and a negative temperature coefficient if coated with paraffin. By building a condenser in two sections, one treated with shellac and one with paraffin wax, the variation of capacity within ordinary limits of temperature can thus be brought practically to vanishing point.

To obtain (3) it is necessary to use only selected sheets of the finest clear "ruby" mica, which must be uniform in thickness throughout the sheet, and free from cracks, veins, or flaws; spotted or "speckled" mica is useless for the purpose. The shellac employed should be the finest button lac dissolved in absolute alcohol and carefully strained until perfectly free from suspended matter. The building-up or assembling of the sheets of foil and mica may conveniently be done on a "hot plate," the greatest care being taken to exclude air-bubbles, grit, or excess of paraffin or shellac. The desiccation should be slow but thorough, and the temperature should not exceed 212° F. The finished condenser should be carefully and not excessively pressed, and should be allowed to cool under pressure in the ordinary way.

The requirements of wireless telegraphy and X-ray work have given rise to quite an appreciable trade in Leyden jars. Like other condensers, these are prone to fail in use if at any point there is imperfect contact between the conductor and the dielectric, and to avoid this difficulty the best plan is to silver-plate the glass by precipitating metallic silver on it The silver coating should be mechanically strengthened by a protecting layer of varnish, or it may be over-plated with copper.

An important development of this silver-plated Leyden jar is to be found in the Moscicki high-tension condenser recently placed on the market. In the author's opinion this condenser represents the most satisfactory and practical high-tension condenser for commercial work which has been introduced up to the present.

An imperishable and highly stable material, glass, is used for the dielectric, a most intimate and complete contact is made between the conductor and the dielectric by chemical deposition of silver, excessive strains are avoided at the point of high dielectric stress (the edges) by suitably thickening the dielectric at this point, and the effects of local heating are minimised by water-cooling. The failures of high-tension condensers of other types have no doubt engendered a certain feeling of distrust in the minds of many station engineers, and it may be that this suspicion will take some time to eradicate. In view, however, of the large number of stations working with a power factor ranging about 0·75, and of the advantages to be gained by improving this power factor, the author would suggest that the question of installing a battery of modern glass condensers at such stations is worthy of more than passing consideration.

In making condensers with paper, the standard practice up to the last decade was to use separate sheets of tissue paper and separate sheets of thin metallic foil, and the method employed was to dry the paper by heat, then to transfer it to a bath of hot paraffin wax, and after due soaking to build up the condenser on a "hot plate," the paper being taken sheet by sheet from the bath of hot wax. At least two sheets of paper were used between consecutive foils, the alternate foils being bunched into two books in the well-known way. The paper used was of fine quality, giving only a minute percentage of ash on incineration, being free from grit, holes, specks, &c., and being neutral in chemical reaction. A good working thickness was 0·001 in. The metal foil was usually of tin, the thickness being about 0·0003 in.

Obviously this method was tedious and expensive, and as the workmen were exposed to a high temperature, the risk of contamination of the wax by emanations from the body was great. In consequence of this difficulty, the author found it of advantage to build up the condenser plates "dry" in a separate room and to desiccate and impregnate the condensers as a subsequent operation. The electrical results obtained were more satisfactory than under the old system, and the cost of manufacture was considerably reduced.

The next step was to wind up into the form of a roll long strips of metal foil, two strips of paper being interposed between each foil —that is, six strips in all. This method, which was introduced to the Post Office by Sir John Gavey in 1899, had, however, difficulties of its own. In endeavouring to overcome these difficulties, the author hit upon the idea of using metallised or "foiled" paper of the same character as that sometimes employed for wrapping up packages of tea, &c. The difficulties in the way of producing a thoroughly reliable conducting surface on such paper were found to be surmountable.

As soon as supplies of good electrical foiled paper became available, the manufacture of condensers on this principle was taken up by the Post Office, and subsequently by various commercial firms, under licence from the patentee.

The tin is carefully precipitated and distributed evenly over the surface of the paper as the latter passes through a machine; the paper is dried and passes to burnishing rolls which compress the dull magma of tin powder into a coherent thin film having the lustre of the polished metal. During this process any comparatively large crystals of tin or particles of grit which may have escaped untrapped will be driven partly or wholly through the paper, but the effect of this is eliminated by the subsequent electrical treatment. Prior to the calendering process the film of tin powder is non-conducting, the conductivity being produced by the action of the steel burnishing cylinders which so consolidate the coating as to bring the particles into intimate contact each with its neighbour. On the foiled paper as usually made for condensers, the quantity of tin averages 25 grains to the sq. ft., and the conductivity is about 25 per cent. of that of pure tin, the resistance of a strip 1 ft. wide averaging 0·3 ohm per sq. ft. run, that is, 0·3 ohm per sq. ft. or per sq. metre. This density of coating gives a surface of 280 sq. ft. to the pound of tin; the average thickness of the tin film is, therefore, as nearly as possible 0·0001 of an inch. Seeing that the material is semi-transparent, the current-carrying capacity of this film is surprisingly high, the fusing current in air being rather more than 1 ampere per inch of width for the standard coating of 25 grains per sq. ft., assuming that the paper has not been creased.

Continuous reels of electrically-conducting foiled paper being available, the manufacture of a condenser is a very rapid and simple operation, since all that is necessary is to roll up together two strips of foiled paper, interleaved with two strips of plain paper, the number of turns being dependent on the capacity required.

The machine usually employed for the rolling operation accommodates two reels of plain and two reels of foiled paper, and is provided with a set of interchangeable winding mandrels of various diameters. The winding of the strips on to the mandrel is usually done by hand if the number of turns per condenser is small, but in some instances more than a hundred turns have to be wound on, and the mandrel may then be power driven with advantage; in this case a mechanical counter becomes essential. The placing of the strips in position and the starting must be done by hand, and this also applies to the insertion of the connecting lugs, which should be strips of annealed copper foil, about 0·001 in. thick and $\frac{3}{8}$ or $\frac{1}{2}$ in. wide. These strips are simply slipped into place between the foiled surface and the interleaving paper, and are so light that they readily retain their position; they should make contact with the foiled surface over practically its full width and should protrude about 1 in., so as to serve subsequently as a soldering point for the wire connection. The two lugs should be placed at the middle of the foiled strips rather than at the beginning or end, so as to avoid interposing any appreciable resistance into the condenser circuit. This plan has the additional advantage that thereby the innermost layers, which possibly may have been rather sharply creased, are not called upon to transmit any considerable current on charge or discharge, as would be the case if the lugs were placed at the inner end of the roll.

In practice it is found that plates of high capacity require appreciably less area per microfarad than those of low capacity. There is therefore a saving in material as well as in labour by building the plates in as large units as possible. The capacity most in demand for telephone work is 2 microfarads, and as plates of this size form a convenient manufacturing unit, they are usually taken as the basis on which to frame standard data for manufacturing purposes. Condensers of larger capacity are almost invariably built up by assembling standard units, rather than by direct manufacture in large plates. The usual sizes of paper at present in use are: for interleaving paper, $7\frac{1}{2}$ or 4 in. wide × $\frac{1}{2}$ mil thick, giving about 400 sq. ft. to the pound; for foiled paper, $6\frac{3}{8}$ or $3\frac{1}{2}$ in. wide × $1\frac{1}{4}$ mils thick, giving 100 sq. ft. of conducting surface to the pound, and consisting of 35 per cent. tin and 65 per cent. paper.

At one time an unfoiled margin was left on each side of the foiled strip, but since the introduction of the "breakdown process" subsequently referred to, this has been found unnecessary. The substance of the paper is gauged on a ten-fold thickness by means of the usual screw micrometer, as specially made with large contact surfaces for paper gauging. With $1\frac{1}{4}$-mil foiled paper and $\frac{1}{2}$-mil interleaving paper, the area required for a 2-microfarad plate is about $12\frac{1}{2}$ sq. ft. for each electrode. The volume of the plate after waxing and pressing is approximately $7\frac{1}{2}$ cb. in., and the weight 7 oz. The insulation between the electrodes taken at 60° F. with 400 volts after one minute's electrification usually lies between 1,000 and 2,000 megohms per microfarad.* Any lower insulation than 1,000 megohms per microfarad is an indication of imperfect desiccation, excessive pressure or faulty material.

By using the utmost care and material of the very highest quality, it is possible to obtain an insulation of nearly 20,000 megohms per microfarad (400 volts, 60° F., 60 seconds). Such condensers are invariably built up of sheets; three sheets of paper are usually interleaved between consecutive foils. Increasing the number of interleaving papers, while increasing the actual insulation of the plate, does not increase the "megohms per microfarad," since the capacity falls in proportion to the rise of insulation.

For certain purposes, such as absorbing the spark across the break of sparking coils, leaky condensers are of advantage, since the high-resistance shunt afforded by the low insulation across the break materially assists in suppressing the primary spark and lessening the pitting of the contacts. The low insulation necessary may conveniently be obtained by rolling up foiled paper without any interleaving paper, the plate being in other respects treated in the ordinary way. The insulation obtainable will usually be of the order of a megohm.

Condensers made of foiled paper have the peculiar advantage of possessing to an almost perfect degree the property which in a pneumatic tire is called self-sealing, and consequently they are practically proof against short circuit, and can be subjected to much higher voltages than is permissible with those made from metallic foil, any momentary short circuits produced by a disruptive discharge being instantly and automatically sealed. This automatic sealing is brought about in the following way:—Owing to the extreme thinness of the conducting film, the small quantity of heat generated at the point of short circuit by the sudden discharge of the condenser through that point is sufficient to cause the film of metal immediately surrounding the point of breakdown to be fused into minute globules. The segregation of these globules from each other and from the surrounding metallised surfaces effectually isolates the point of breakdown, and the defect is instantaneously sealed up. So rapid, indeed, is this effect, that if a pin is stuck into an insulated charged condenser so as to produce short circuits between the foiled papers, the short circuits seal up without fully discharging the condenser, and a dozen or more of such short circuits may be created one after the other before the condenser becomes fully discharged. Consequent upon the observation of such an effect as this, the author conceived the idea of electrically treating the foiled paper before making it up into condensers in such a way as practically to eliminate all pinholes or defective places, by subjecting them momentarily to currents of such strength as to produce a minute non-conducting ring round each defect, thereby isolating it from the surrounding surface. The apparatus for doing this is of the simplest character. All that is necessary is to pass the paper, foiled side uppermost, over a conducting roller, and to maintain a suitable potential difference between the roller and the foiled surface. When any pinhole or weak place in the paper reaches the roller a short circuit occurs, and the momentary rush of current, concentrated round the defect, produces a bright spark at the defective spot on the foiled surface. As in the case of the finished condenser, the effect of this spark is to isolate the defect by volatilising or fusing the film of metal immediately around it. In this way all the weak places in the dielectric are detected and isolated before the paper is brought into use, and in consequence it is possible to use thinner paper, both foiled and plain, than would otherwise be safe. The process of isolating or removing these faults is quite automatic, and the apparatus once set requires practically no adjustment; all that is necessary in this respect is to see that the current at the moment of short-circuiting is sufficiently strong to fuse the metallic film in the immediate neighbourhood of the defect, but is not so strong as to burn the paper. If current from lighting mains is employed, a series resistance is necessary to limit the short-circuit

* The expression "megohms per microfarad," though incorrect, is generally employed; it should be interpreted as "megohm-microfarads."

current. With 100 volts this resistance should be about 15 ohms, and with 200 volts about 150 ohms. Experience shows that the searching effect of the voltage is increased by connecting a condenser of considerable capacity, say, 20 microfarads, across the

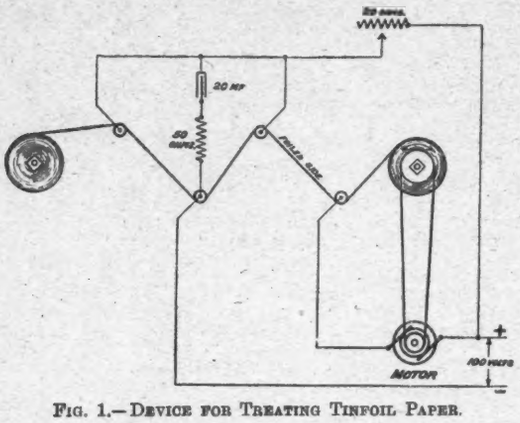


FIG. 1.—DEVICE FOR TREATING TINFOIL PAPER.

potential terminals, but a series resistance of about 50 ohms in the condenser circuit is needed to tone down the suddenness of the condenser discharge.

There is little to be gained by using more than 200 volts for this process if the condensers are for telephone or telegraph work. The device works quite satisfactorily with alternating current. When the breakdown device is driven by an electric motor it is of advantage to have two rollers making contact with the foiled side of the paper at separate points, preferably not less than 2 ft. apart; the current driving the motor may then be led along this strip of foiled paper between the two rollers, so that should there be any break in continuity in the foiled surface the current driving the motor would be broken when the fault passed the first roller, and the stopping of the machine would call attention to the want of continuity. Such breaks rarely occur. Fig. 1 shows the connections of the "breakdown" rollers as arranged for motor driving.

The condenser plates having been wound then pass to the drying oven, and subsequently to the vacuum pans and screw-presses. The desiccation of the plates prior to waxing must be very complete and thorough if the highest insulation is required. Ovens heated by gas, steam, and electricity are in use for this purpose, but the last-named is infinitely preferable. The ease with which the temperature can be controlled, and particularly the facility with which the heat can be kept to its legitimate purpose instead of being dissipated throughout the shop, and the absence of objectionable fumes and of steam joints, which always give trouble sooner or later, are advantages sufficient to place this form of oven easily first. For an oven of about 25 cb. ft. capacity which will accommodate 500 2-microfarad plates, a power consumption of 2 KW. suffices. In seeking for means to introduce heat into the interior of the condenser, and thereby to expedite the drying process, the author tried the plan of utilising the resistance of the strip of foiled paper to generate heat in the interior of the condenser when a current of suitable strength was passed along it. This method did not lend itself very readily to commercial manufacture on the large scale, but it eventually led to the use of a simple process which has been found most satisfactory and efficient, namely, the vigorous churning of the heated air inside the oven by means of a fan, which permits of temperatures as high as 290° or 300° F. being employed without

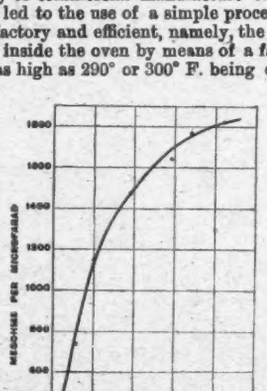


FIG. 2.—FOILED PAPER CONDENSERS. Average Insulation (300 Volts, 60 Seconds, 60° F.) after various Periods of Drying.

scorching the paper. In this way satisfactory desiccation can be obtained in as short a time as eight hours.

Fig. 2 is a graph of the insulation of various batches of foiled-paper condensers, which were subjected to different periods of drying under the conditions indicated above.

After being effectively desiccated the plates have to be impregnated with paraffin wax. The function of the paraffin is threefold:—

1. To increase the inductive capacity of the dielectric.
2. To prevent moisture from again reaching the highly hygroscopic paper.
3. To retain the condenser in the closely compacted form into which it is compressed while the wax is hot.

The inductive capacity of the layers of paper and air which separate the electrodes before the plate is impregnated is approximately 1·2, and on the air being replaced by paraffin this increases to approximately 3·2. The gain in capacity due to impregnation under vacuum averages 11 per cent. An obvious way of doing this is to exhaust the air from the pan containing the condensers, and then after complete evacuation to run in the hot paraffin; but equally good results can be obtained by simple exhaustion over the wax—that is to say, by plunging the plates into a pan of hot wax, fastening the lid, and then maintaining a vacuum in the upper portion of the pan. Two hours' impregnation at 212° F. is sufficient if a thoroughly good vacuum is obtained. After full impregnation the vacuum is broken and the condensers are left subjected to atmospheric pressure for ten minutes, and are then removed from the hot wax and at once pressed. No advantage can be traced from the employment of more than atmospheric pressure in the pan after evacuation is complete.

For a condenser which is required to maintain its insulation and capacity for many years, it is of first importance that a good body of wax be left in the plate. The presses are therefore water-cooled both on the top and on the bottom. Experience shows that more uniform results can be obtained with screw presses than with levers and dead weights, and the latter form has consequently been altogether abandoned at the Post Office factory.

As soon as the plates are fairly cold, they should be placed aside to settle down in temperature before being tested, and in the meantime they should be protected from atmospheric moisture. Paraffin is markedly hygroscopic, and it is important that the

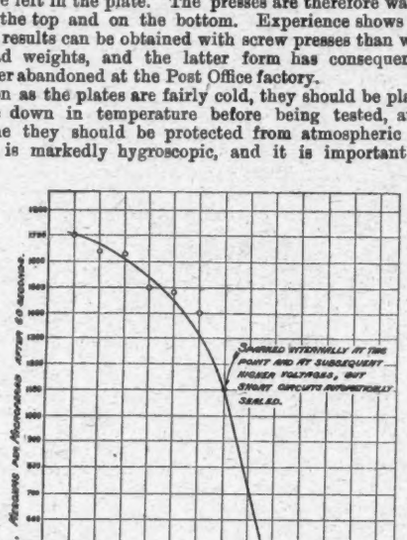

INSULATION. MEGOHMS PER MICROFARAD AFTER 60 SECONDS.
SPARKED INTERNALLY AT THIS POINT AND AT SUBSEQUENT HIGHER VOLTAGES, BUT SHORT CIRCUITS IMPERFECTLY SEALED.
TEST TAKEN AT 62° INSULATION CORRECTED TO 60° F.
CONDENSER PRACTICALLY DESTROYED.
VOLTS. DIRECT CURRENT.

FIG. 3.—FOILED PAPER CONDENSERS. Curve showing Relation between Testing Voltage and Observed Insulation.

outer layer of wax should not be allowed to absorb moisture before the condenser is hermetically sealed; otherwise the insulation will steadily fall, as the moisture diffuses throughout the mass.

Various waxes and mixtures have from time to time been proposed for condenser work. The author has, however, been unable to find that any one of these substitutes possesses the all-round advantages of good paraffin.

In all stages of condenser manufacture, handling by the workmen should be restricted to a minimum, and no operative who is inclined to perspire freely should on any account be permitted to handle the plates prior to boxing.

The plates should be sealed hermetically in metal cases as soon as possible after manufacture.

With ordinary paraffined paper at 60° F., the breakdown-point is approached when the pressure reaches the equivalent of 150,000 volts per centimetre. With foiled paper, however, the result of the automatic sealing is practically to double the effective dielectric strength.

Fig. 3 shows graphically the results obtained on subjecting an ordinary telephone condenser, made from foiled paper, to steadily increased pressure. As the voltage rose above the normal point of dielectric strength the paper broke down, possibly at several places, but each short-circuit sealed up as fast as it was formed, and not until the pressure reached 1,200 volts was the condenser rendered useless.

For telegraph condensers, which are generally required to be adjustable, separate condensers of suitable capacity are selected, and after a preliminary test are assembled between a pair of sheet-iron plates, which are then bolted together. The batch of plates so assembled is built up into a solid mass with plastic paraffin, and is then hermetically sealed in a tinned-iron case, the opening where the wires are brought out being sealed with a non-contracting mixture of gutta-percha, resin, stearine pitch, and Stockholm tar.

For telephone work nothing more is necessary than a hermetically sealed metal case, since the condenser is usually covered up and protected by the telephone apparatus.

In speaking of the insulation resistance of a condenser it is necessary to be most precise as to exactly what is meant. The insulation is usually expressed either in terms of the percentage loss of charge after the charged condenser has been insulated for a certain time, or as so many megohms per microfarad. For the loss-of-charge method the periods of charge and of insulation have to be stipulated. The latter period is commonly taken as 1 minute, but the period of charge is not so well standardised, 15 seconds being taken by some observers and 60 seconds by others. The pressure often employed for this test is 100 volts.

With respect to temperature, 60° F. is in this country the standard generally accepted for tests made by both methods.

The voltage adopted for the "direct deflection" or megohms-per-microfarad method varies according to the nature of the duty demanded of the condenser. The period of application of the pressure in this case is usually 2 minutes; the leakage is measured at the 60th second after the moment of application, and the insulation is calculated on the basis of that moment's reading. During the whole period of the test the leakage should steadily decrease; and as a measure of this absorption or "electrification," it is usual to take the difference between the readings at the end of the 60th and the 120th second respectively, and to express this difference as a percentage of the reading at the 60th second. With a good condenser this percentage will usually fall between 25 and 35 if the test is taken at 60° F. The degree of electrification falls markedly with a rise in temperature. The behaviour of a condenser in respect to electrification is an important indication of its quality, as incipient defects give the first indication of their existence by producing unsteady or "negative" electrification.

With constant voltage and varying temperature the correcting coefficient for foiled paper condensers is as nearly as possible 3·50 per cent. per degree F. or $Y_{60} = Y_t\ 1{\cdot}035^{t-60}$, where Y_t and Y_{60} are respectively the observed insulation resistance at $t°$ F. and the corrected insulation resistance at the standard temperature of 60° F. This assumes that the insulation is measured after 60 seconds' application of a pressure of several hundred volts.

A special development of the paper condenser is the "inductive-resistance" form introduced by Dr. Alexander Muirhead for the balancing of long submarine cables. This, as is well known, differs only from the tinfoil condenser in that one set of electrodes consists of plain sheets bunched together, while the other set consists of sheets of foil cut into the form of a grid. The strips forming the grid are joined in series and serve as a resistance.

The manufacture of such artificial cables is very expensive, owing to the difficulty in handling the thin grid of tinfoil; this may, however, be overcome by the use of foiled paper, since, owing to the thinness of the conducting film, the strips are much wider than if made of metal, and they are, consequently, more easily handled. In illustration of this it may be said that artificial cables of very high $\frac{\text{resistance}}{\text{capacity}}$ ratio have been constructed of foiled-paper strip without difficulty.

Electrolytic cells have not been received with much favour in this country, but they were at one time used to a considerable extent in Germany for common battery telephone work. They have, however, been almost entirely discarded in favour of paraffined-paper condensers. The only advantage which these "polarisation cells" possess over condensers is with respect to size, a cell, or a set of cells capable of stemming back a direct current of 25 volts having a volume of only about 5 cb. in. On the other hand, the cost of such a set of cells is from three to four times that of a condenser of equal effectiveness. The disadvantage of the polarisation cell is that it is more or less leaky, both electrically and mechanically.

Discussion.

Sir John Gavey, who opened the discussion, said the introduction of the method of rolling at Mount Pleasant, was due to a hint received from America; Mr. Mansbridge's evolution of the paper foil was very ingenious and successful. In theory the condenser was a huge lightning arrester, but in practice it absorbed discharges perfectly, as regarded telegraph work. Condensers were used in telegraph and telephone work in enormous numbers; their use had allowed of the introduction of universal battery working at places which ordinarily would be worked by independent batteries. They would probably be found on all telegraph circuits in the future.

Mr. J. E. Kingsbury referred to an early mention of the condenser in the U.S. Patent records. A patent was issued by that department in 1879 for the use of a condenser in place of apparatus previously used by the same inventor, and it was interesting to note that this condenser was in the form of a glass tube filled with glycerine and water, much in the same way as the Moscicki condenser. It was proposed to use this with a telephone circuit. In 1896 the central battery system was being developed; this eliminated the magneto, and it was necessary to produce a cheap and efficient condenser, which was constructed of tinfoil and paper rolled together, and could be turned out in millions instead of hundreds at consequent reduction in cost. He appreciated Mr. Mansbridge's arrangement, which his company's London factory was adopting.

Mr A. Whalley said the author dealt with the condenser in its connection with telephone and telegraph work, but it was also of interest at the present time in connection with lighting. Condensers could be used in metallic filament lamp circuits with small transformers, and would improve the power factor at a very small cost; they could be made for pressures of 220 or 500 volts. At Helsby it was usual to test them to 500-600 volts, and this pressure they withstood for considerable periods.

Major O'Meara gave some statistics as to the use of condensers in this country, from which it appeared that there were some 80,000 in use on telephone and 6,000 in use on telegraph circuits.

Mr. Taylor referred to the trouble with brush discharges when using the Moscicki condenser in wireless telegraph work; he bore testimony to the self-sealing properties of the Mansbridge condenser, which could be used for shunting electro-magnets, even on 100-volt circuits, without giving trouble.

Mr. W. M. Mordey, in connection with the use of condensers in electric power work, said he thought it was important to find out what energy was lost in heating, &c., in the condenser; it was possible that such losses would equal those in transformers in use. He thought that static attraction between the dielectrics accounted for a good deal of heat loss, and it would be advantageous to thoroughly test the matter.

Col. Crompton said that during the South African war, great use was made of condensers in portable telephones, these enabling speech to be made through circuits with a break of some feet, or a buzz through a break of several yards. This was when all regular telephonic and telegraphic communication was broken.

Mr. Mansbridge, in reply, said as regards the use of the condenser on lighting circuits, if the consumer was willing to pay for them, it was a very happy suggestion. At the P.O. factory they had found only slight differences between A.C. and D.C. tests on condensers. As regards the rolling apparatus, the really bad places were burnt out at the first roller, and subsequent rollers discovered minor faults which would scarcely affect the practical working. Probably if taken through a dozen times, some faults would be found, but it must be remembered that dielectric strength was a function of time.

Mr. G. L. Addenbrooke (communicated): Mr. Mansbridge's work does not appear to have led him, so far, to seriously consider the losses in the dielectric when submitted to alternating pressures over considerable periods and the heating which then occurs, and which as well as the cost of manufacture has been the chief deterrent to the use of condensers hitherto in connection with the transmission and use of alternating currents for power supply. For some time the writer has been impressed with the value of measuring the losses in dielectrics, not only for their importance in themselves, but because so much other information regarding the behaviour of the dielectric under different conditions can be obtained in this way. By the use of the electrostatic watt-meter which the writer brought out some time since, with certain modifications, it is possible to measure the losses in capacities as small as $\frac{1}{10000}$th of a microfarad and at any voltage which may be required from, say, 500 volts upwards and at very low power factors. Great differences in the losses occur in condensers and cables, depending on their construction. A paper condenser showed a loss as low as $\frac{2}{3}$ of 1 per cent. of the apparent loss, which means a loss of about 3·5 watts in a 1-microfarad condenser submitted to an alternating current of 33 periods and 1,000 volts; but in most cases the losses are much larger, and with bad construction may amount to from 30 to 40 per cent. It must be borne in mind also that the charge of the condenser depends on the shape of the alternating wave, and with a high peak the current flowing in and out of the condenser is larger than would be deduced from the voltmeter reading, which reads the root of mean square of the volts. Consequently the capacity appears higher. The writer is convinced that the testing of condensers and cables by taking their losses at different pressures will before long become a recognised method of testing.

The Faraday Society.

The Planimetric Analysis of Alloys.

A useful extension of this ingenious application of metallography to the study of the phosphor-copper alloys was described before the Faraday Society at the April meeting, on the 28th ult., by Prof. A. K. Huntington and Dr. C. H. Desch. As is well known, if an alloy be highly polished and then etched with suitable chemical reagents, its various structural constituents are acted upon in different ways, or to different extents, so that they may be visibly distinguished under the microscope. Under certain circumstances, the process can be carried a stage further, and *quantitative* results obtained as to the composition of the alloy under treatment. Obviously, in cases where the alloy contains only one structural constituent, such as where there is a definite intermetallic compound, or a homogeneous solid solution (*e.g.*, the gold-silver, iron and manganese, or nickel-cobalt series), the quantitative examination of an etched section is impossible, but in cases where two solid constituents of known composition are visible, or where the alloy is a eutectic mixture, or consists of a solid constituent surrounded by a eutectic, planimetric measurements of the two constituents can be carried out, and from the figures so obtained the composition of the alloy is easily calculated. It is, of course, essential that the alloy be in a state of structural equilibrium, and the freezing point and transformation curves of the alloy under treatment must therefore first be accurately known.

To apply the method in practice, the magnified image of the prepared section of the alloy is projected on to a sheet of paper and the outlines of the constituents traced with a pencil. The areas of the constituent with the most clearly developed outline are then measured with a planimeter, or the field may be divided up into small squares, the relative constituents of each square being estimated. The whole process of preparing the specimen and

measuring the projection can be completed in a little over half an hour, so that the method is far more rapid than an ordinary analysis.

Prof. Huntington and Dr. Desch have fully tested the method—which has already been applied to some extent for the estimation of carbon in steel—for the case of the copper-phosphorus alloys, an important series used in the manufacture of phosphor-bronze and other copper alloys containing phosphorus. After making a correction for the segregation, in a belt round the copper crystallites, of copper phosphide which separates out in cooling from the copper-copper phosphide eutectic, the results show remarkable agreement with the percentage of phosphorus obtained by analysis. The method should become one of considerable practical importance, not only, as in the case of phosphor copper or phosphor tin, as a rapid and accurate works method for analysing day by day a given special alloy, but as an instrument for research. It was suggested, for example, by Prof. Gee, that it could be used to compare the relative actions of different etching reagents—including electrolytic etching, where the metal under examination is used as an anode—which are used in the micrographic examination of alloys, and so throw light on the mechanism of the etching process.

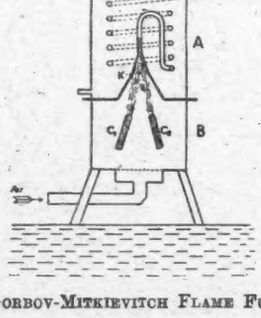
The Direct Combination of Aluminium and Carbon.—A New Method of Fixing Nitrogen.

At electric furnace temperatures aluminium and carbon easily combine to form the carbide; but Messrs. F. E. Westen and H. Russell Ellis have now shown that intimate mixtures of aluminium powder and carbon, in its various forms, can be made to unite spontaneously if the reaction be started locally at a high temperature with a fuse of magnesium powder and barium peroxide, as in the Thermit reaction. As to the cause of the reaction the learned doctors differ; the authors ascribe it to initial oxidation of the carbon by atmospheric oxygen, while Dr. Perkin and others give cogent reasons for supposing it to be initiated by the burning of the aluminium. When the reaction takes place in air, nitrogen takes part in it, a certain proportion of aluminium nitride being produced, probably by direct combination at a high temperature with the aluminium carbide. In this connection Mr. Ellis makes the interesting suggestion to heat clay and carbon in the electric furnace so as to produce a crude aluminium carbide, and then with this, to fix atmospheric nitrogen as in the fixation of it by the union of calcium carbide and nitrogen to form cyanamide. Should the resulting aluminium nitride be as satisfactory a manure as is cyanamide, we have here a most promising method of economically making artificial fertilisers, and the matter is well worth the serious attention of experimenters working in this direction.

Technical Electro-Chemistry in Russia.

Prof. Piltschikoff, of the Technical Institute, Kharkov, gives a few interesting details regarding electro-chemical works in Russia. It appears that three works are manufacturing caustic soda and bleaching powder—Lubunoff, Solvay & Co., Zabkowickie Electro-Chemical Co., and the "Elektron" Co. Messrs. Siemens have a copper refinery at Kalakant, but this is not working at present. An electrolytic refinery at Moscow produces annually 500 tons of electrolytic copper, 1 ton of silver, and 80 lb. of gold, besides tin, nickel, and chromium. There is also a copper refinery at St. Petersburg. At the Boleslav mines, the Laschinsky electrolytic method of copper extraction is used, the special feature of which is the prevention of oxidation of iron at the anodes, and hence loss of current, by coating these with lead, the electrolyte being constantly stirred.

The process of Profs. Gorbov and Mitkievitch, of the Institut Polytechnique, St. Petersburg, for the oxidation of atmospheric nitrogen, is about to receive technical application. The arc furnace employed is a very simple one. A current of air draws the arc into



The Gorbov-Mitkievitch Flame Furnace.

a worm, as shown in the accompanying diagram, in whose mouth is formed a "bunch of fire" through which all the air has to pass. It is then cooled in the worm, which is placed in an oil or water bath A. The electrodes C_1 and C_2 are of carbon or metal, and either continuous or alternating current can be used, at a terminal voltage of 1,000 to 3,000. One would not at first sight expect a very high efficiency with this type of furnace, as the cooling of the gases after leaving the arc does not appear to be as rapid as is desirable; but, nevertheless, the respectable figure of 56 grammes of HNO_3 per KW.-hour is stated to have been yielded in a 14-KW. experimental furnace.

Other Russian processes mentioned by Prof. Piltschikoff are Kloboukoff's method of tanning hides by means of the electric current, which prevents fermentation in the bath, and Danilevsky's process for depositing copper on leather; but no details of either are given. The purification of water by ozone is being experimented with at St. Petersburg; and at Moscow, Prof. Sckotoff's ozoniser, which is stated to be powerful and economical, is being tried; but here again no further details are as yet available.

LEGAL.

Taylor v. United Electric Light and Power Supply Co., Ltd.

In the Lancashire Chancery Court, sitting at Manchester, on Monday, Vice-Chancellor Leigh Clare heard this case. Counsel for the plaintiff (Mr. Cunliffe) said that it was a debenture-holder's action. The registered offices of the company were in Manchester. It was incorporated in 1901, and at the time when the debentures became enforceable its business consisted almost entirely of supplying Guimaraes, a town in Portugal, with electric light. It was considered that the debentures were a good charge upon the company's assets in that country; they were of considerable value, and a receiver (appointed by the Court in December last) was sent out to inquire into the state of affairs. He found that, in consequence of the debentures not having been registered according to Portuguese law, they ranked after the claims of the creditors in Portugal, secured and unsecured. In the first place, a bank had a charge upon the assets; then the other creditors; and thirdly, the English debenture-holders; and it was thought that if the assets were realised they would not furnish enough to pay off the first two sets of claims. The receiver, therefore, came back and called the debenture-holders together. They decided that the best course was to stay all proceedings, discharge the receiver, and take their chance of anything resulting if the creditors in Portugal carried on the business. They proposed to appoint a receiver, under a power in their security, to look after their interests.

Mr. Lawley, on behalf of the company, assented to the application.

The Vice-Chancellor made an order discharging the receiver, and staying proceedings until further orders.

The Rating of a Light Railway.

In the House of Lords on 8th inst. the appeal from a decision of the Appeal Court in the case of Wakefield Corporation *v.* Wakefield and District Light Railways Co. was heard. The question was one relating to the assessment of tramways for rating purposes, whether certain lines should be assessed at their full net annual value or only one-fourth thereof. The last hearing was reported in our issues of March 22nd and 29th, 1907. It was then found that the undertaking in question was a railway and not a tramway, and was entitled to the exemption given to railway companies in Section 211 of the Public Health Act, 1875. The Corporation's appeal was then dismissed, and the House of Lords have now affirmed that decision.

Ernest Scott & Mountain, Ltd., *v.* The Kent Collieries, Ltd.

(*Continued from page 773.*)

On May 7th Mr. Lancaster, one of the directors of the defendant company, was called and examined by Mr. Bousfield. He said that the different incidents which had been referred to in the course of the case were incidents which were always to be met with when pumps had to be made. He received assurances from the plaintiffs that, notwithstanding those things, the pumps would be capable of doing the work required. Plaintiffs' estimate was considerably higher than many of the others who had tendered. It was never suggested that it would be necessary to have two pumps working together in the shaft. Prior to the breakdown, it was never suggested that there should be two pumps going down to the 620 ft. level, one to work at one time and the other at another. The breakdowns had a very prejudicial effect upon the company; in fact, it was absolute ruination. They had raised a large sum from the public—£200,000—and they had very little of it left.

Cross-examined by Mr. Russell: His manager might have contemplated before the breakdown having two pumps in the shaft, but it certainly was never contemplated having the pumps at the same level. Witness made up his mind that the engines were not capable of performing their duty with the specified coal consumption from the very beginning. They were only doing half load and were burning far too much coal. He made up his mind that the motors were not according to contract after the first breakdown occurred in August, 1906. It was quite true that they decided to go on using the engines and pumps. It had always been declared by the plaintiffs that the defects were only minor ones and could soon be put right. It turned out, however, that the defects were very much more than minor ones. The defendant company was

not the first to take over the collieries in question; three or four companies had run them before. He understood from the records that these companies had used all sorts of pumps, except electric pumps. Of course there had been breakdowns, because there always were in colliery pumping. Why so many sorts had been tried was because the coil in that part played havoc with all pumps.

Re-examined by Mr. Bousfield, Witness said there was no more difficulty in pumping in the pits in question than in any other colliery, with one exception, and that was that the composition of the water was a little worse than was generally to be found. It was more erosive in its character and contained mineral salts, which attacked the iron of the pumps. With the pumps in question the water was ejected by propellers, but witness did not think that if these propellers became eroded it would in any way cause the breakdown of the machinery. It was the driving plant of the installation which was wrong. In answer to further questions, witness said he ridiculed the idea of using two pumps to deal with a depth of 620 ft., and the plaintiff company did not at first suggest that two pumps were necessary. The defendant company had never p'aced the slightest impediment in the way of alterations being made to the pumps in order to make them do their work properly. With regard to the test, it was not the fault of the defendant company that it never came off—the plaintiffs refused to allow the test to be taken. There were weeks when the pumps were running idle, and there was nothing at that time to prevent the test being taken.

Prof. Ed. Hull, a director of the defendant company, said that he was greatly interested in the development of the Kent coalfields, and before he joined the board he prepared, at their request, a report of the geological conditions of the colliery. Witness was present at the interview between the parties on December 13th, 1905, just before the contract was finally entered into. To the best of his recollection nothing was said at that time about having two pumps to deal with a pit 620 ft. deep. He understood that two pumps were to be obtained, one to do the work and the other to be used as a stand-by. At a later interview plaintiffs admitted that the pumps had broken down, and it was decided that a third pump should be obtained.

For convenience' sake, Mr. Russell postponed cross-examination of this witness, and

Mr. Wm. Thomas, a certificated colliery manager of 42 years' experience, was called. He said he had examined the Kent collieries, and on the occasion of his first visit, the plaintiffs' pumps were not installed. He saw the tackle supplied by the defendants for moving the pumps, &c., and in his opinion it was quite sufficient for the purpose. In witness's experience he had never known of two pumps being placed in a shaft and working alternatively.

Cross-examined by Mr. Russell, Witness admitted that he had never seen an electric suspended pump working in a colliery shaft, nor did he know the weight of such pumps with motors, &c., nor was any information given him with regard to the matter at the time. Asked how he could form any opinion as to the efficiency of the tackle under such circumstances, witness replied that his own experience told him that the head framing over the colliery shaft would have supported 40 or 50 tons. There was also a steam crab there which was very large and strong. Witness did not think a crane was necessary. With the appliances there were, it should not have taken more than a few hours to lift the pump out of the pit mouth. He should certainly never think of using the spare pump until the other one had broken down. All the time one pump was doing the work there was no need to use two.

Re-examined, Witness declared that it was absolutely unnecessary to lay down a 25-ton crane at the pit mouth for the purpose of lifting and placing the pumps in position.

Mr. James Fell, manager of the defendant colliery, examined, said that it would have been possible to get to the bottom of the 620-ft. level with an ordinary pump in about a fortnight. He was not an electrician, so he could not say technically what was the cause of the breakdown. Speaking as an engineer, he came to the conclusion, after the breakdowns in September and November, that the power of the pumps was such that they could not take a full load. In his view, no test could show better the actual working of the pump and whether it was capable of taking the full load than that which took place on November 17th. Under the test conditions, the No. 3 pump at full load took from 25 to 30 tons of coal.

On Friday, May 8th, Mr. Fell, in cross-examination by Mr. C. A. Russell, said that as the pump went down into the pit, they had to put on new lengths of pipe, and to enable that to be done, taps had to be put into the shaft. That was not completed until August or the middle of September. He drew up a report day by day. On July 31st they had not even commenced the work for the second stage. That was because it was covered with water. In the early part of October they had only one pump at the colliery. On October 1st a meeting took place between Mr. Hodgkin and some of the directors. Between October 1st and 12th the No. 1 motor was rewound again at the colliery, and it was ready to go on working again in the shaft on October 12th. There was some pumping going on between October 1st and 12th, however. On October 25th they were not ready with the winch rope for the second pump, so that Morley was unable to erect the second pump at that time. Witness could not say that on November 2nd Morley was engaged in erecting the second pump at the pit mouth, but he admitted that upon his own notes he had an entry of that date, which stated that "no new pipes were put on because of the erection of the second electric pump." He could not say that Morley often pressed him to complete arrangements in order to have both the pumps in the shaft at the same time. The arrangements for lowering the second pump were completed on November 3rd, but they had no time to get it down in the shaft before the other pump failed. On November 17th arrangements were made for working the pumps in series; one on the longbye level and one on the shaft bottom. He denied that when they proceeded to lower No. 2 pump into the shaft it was found that defendants had not supplied a long enough wire rope to enable the pump to reach the water level.

Counsel: Why did you change No. 2 pump over to No. 1 pump's rope, then?—Because the telescopic pipes and arrrangements at the pit top made it more convenient to do so. As a matter of fact, the rope which counsel had referred to as being too short had since supported No. 3 pump down to the bottom of the pit shaft.

Counsel: But you changed the position of the capstan?—Witness admitted he had done so, but only because it had to support a 3 tons heavier pump.

Mr. W. J. Horner, a director of the defendant company, examined, said he was a director of the old company, and joined the board of the new company on its formation. He took an active part in the management of the affairs of the company. He had been in Court and had heard all the evidence given on behalf of the plaintiffs. He never heard a suggestion that both pumps were to be kept in the sinking shaft at the same time. Mr. Lancaster and he both came to the conclusion that the pumps singly would not do the work they were intended to do.

Mr. Henry M. Sayers, examined by Mr. Bousfield, K.C., said he was a member of the Institution of Electrical Engineers and a consulting engineer practising at Westminster. He had had a good deal to do with electrical and steam machinery for pumping and other purposes. He inspected the machinery at Dover, and made a report to the defendants on October 31st. With regard to the motors, he was of opinion that they were not capable of carrying the full guaranteed load. He made calculations from the dimensions of the motors and the probable amount of heat loss. Comparing the probable amount of loss with the surface by which the heat had to escape, he found that the quantity of heat lost per unit of surface was about four times as great as that usually allowed. The usual limits of the rise in temperature were 70° F., but in this case the temperature was 1½ to 2 times the usual limit. He attributed the breakdown which took place on October 17th at a depth of 550 ft. to faulty construction and overheating. A motor of this kind required something in the nature of forced ventilation, and that difficulty could be got over by ventilating arrangements. It was successfully overcome when the alterations were made in No. 3 motor. Witness said that when cotton got charred, that was not good insulation. This effected the breakdown, because there were leakages of current through the charred cotton, which set up sparking and caused rapid local deterioration and short-circuits at the turns.

(To be continued.)

Exhaust Steam Turbines.—In Rateau's system of utilizing exhaust steam by means of turbines, ordinary engines, such as those of the rolling mill or of the winding gear, are allowed to exhaust into a closed vessel, where the water and oil are deposited, and whence the exhaust steam is conveyed to the condenser by way of the turbine. The water in the vessel is only allowed to accumulate to a given level, but a considerable quantity is always present, and acts as a heat store. Rolling and winding engines, of course, discharge intermittently into this vessel, and heat is stored, which becomes available for evaporation if the pressure falls, as it must when the entrance of exhaust steam stops and the outflow to the turbine continues. By this means a continuous flow of steam to a turbine is brought about with intermittent supply of steam from the exhausts.

In all condensing engines the steam rushes into a more or less vacuous condenser at a very high velocity, and all this energy of movement is reconverted into heat by collision of its molecules with the walls of the condenser, the condenser being made hotter than it otherwise would be. Such, at least, would be reasoned out to be the case by the kinetic theory of gases. Not so, however with the Rateau system. The exhaust steam rushes just as quickly to the condenser, but on its way it encounters the blades of the turbine, and gives up to these its energy of translation and thus conduces to economy. In one case a 500-kw. plant was kept running from the exhaust vessel without any further supply of exhaust steam having been added during a period of four minutes. Ultimately, of course, without further steam the vessel would become cold; indeed, with an air pump the heat vessel would ultimately become frozen.

This use of the turbine with exhaust steam is simply on a par with the use of exhaust steam in the injector. The effect of the kinetic energy of the steam is simply secured by digging a heat pit, into which the steam may fall at the rate of probably 1,800 ft. per second, and make use of its molecular energy by the acquisition of velocity to be utilised through the agency of the turbine blades.

It has been suggested that a water turbine could be worked by a species of exhaust steam injector, mixing the steam with, say, five times its weight of water, but the familiar energy formula $E = \frac{m v^2}{2 g}$ precludes this, for the reduction of v sixfold implies a reduction of energy to one-thirty-sixth, and m has increased six times, so that there is a net loss of sixfold. The steam must, therefore, be used as steam, with all its possible velocity of motion unreduced by any mixture of water.

NEW PATENTS APPLIED FOR, 1908.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

9,090. "Improvements in insulating machines for electrical apparatus." J. F. Simpson and A. W. Brown. April 27th.

9,092. "Improvements in the making of sparking or ignition plugs for use in gas or petrol engines and the like for motor vehicles or other purposes." J. A. Mason. April 27th. (Complete.)

9,097. "Improved holders for tungsten filaments in electric lamps." Deutsche Gasglühlicht Akt. Ges. (Auergesellschaft). (Date applied for under Sec. 91 of the Act, February 13th, 1908, being date of application in Germany.) April 27th. (Complete.)

9,099. "Trolley for electric railways and tramways." A. Wehrmann. April 27th. (Complete.)

9,128. "Improvements in flexible stands for supporting electric and other lamps." F. G. Grimler and H. A. Neyland. April 27th. (Complete.)

9,133. "Improved electro-motor." I. M. Hawkins. April 27th.

9,146. "Improvements in and relating to electric transformers." Akt. Ges. Brown, Boveri & Cie. (Date applied for under Sec. 91 of the Act, April 26th, 1907, being date of application in Switzerland). April 27th. (Complete.)

9,156. "Improved device for opening and closing an electrical circuit, more particularly intended for testing the ignition of multiple-cylinder internal combustion engines." F. H. Wynne. April 28th.

9,195. "Improvements in automatic electric lifts." C. G. Major, E. C. Stevens and P. H. Stevens. April 28th.

9,203. "Improvements in and relating to signalling apparatus for electric railways and tramways." P. J. Pringle and G. W. Green. April 28th.

9,222. "Improvements in electric arc lamps." C. A. Carpenter and O. T. Banks. April 28th.

9,229. "Improvements in and relating to electrically-controlled clocks." W. T. Giles. April 28th.

9,231. "Improvements in electrical railway signalling systems." W. H. Lewers. April 28th.

9,232. "Improvements in electrical railway signalling systems." W. H. Lewers. April 28th.

9,237. "Improvements in and relating to devices for protecting transformers, cables and other electrical apparatus." Allgemeine Elektricitäts Ges. (Date applied for under Sec. 91 of the Act, April 29th, 1907, being date of application in Germany.) April 28th. (Complete.)

9,241. "Improvements in electric arc lamps." A. D. Jones. (Applications for Patent of Addition to No. 3,060/1907.) April 29th.

9,254. "Improvements in electricity integrating meters." R. Kennedy. April 29th.

9,257. "Improvements in incandescent electric lamps." J. Cochran. April 29th.

9,260. "Improvements in or relating to electrical contact-breakers for use on internal combustion engines." S. S. Guy. April 29th.

9,288. "Improvements in electricity meters for use in connection with the charging and discharging of storage batteries." H. Aron. April 29th. (Complete.)

9,289. "Improvements in multiple-tariff electricity meters." H. Aron. April 29th. (Complete.)

9,291. "Improvements in and relating to electro-magnets." M. Kottra. April 29th.

9,309. "Improvements in radiation receivers." H. L. Callendar. April 29th.

9,323. "Improvements in mechanical connectors for electric cables." J. Stratton and E. A. Claremont. April 30th. (Complete.)

9,324. "Improved arc lamp coupling." R. T. Vigar. April 30th.

9,335. "Improvements in electrical and attendant arrangements for controlling the locking and unlocking of railway carriage and other doors." F. Brown and R. J. Rudall. April 30th.

9,360. "Trolley head for electric tramcars." J. O. Millard. April 30th. (Complete.)

9,362. "Improved suspending device particularly applicable for use with gas, electric or other lamps." W. H. Chipperfield. April 30th.

9,405. "Improvements in plates for electrical accumulators." L. Meriguet. April 30th.

9,449. "Improvements in or relating to electrically-operated heating devices." F. Krupp Akt. Ges. Germaniawerft. (Date applied for under Sec. 91 of the Act, June 24th, 1907, being date of application in Germany.) May 1st. (Complete.)

9,471. "Rotary pump electrically-driven direct connected operating automatic and with an alarm sounding device." J. J. O'Donnell. (Application for Patent of Addition to No. 8,766/07.) May 1st. (Complete.)

9,479. "Improvements in supporting hooks for electric glow-lamp filaments." W. Schaffer. (Date applied for under Sec 91 of the Act, May 3rd, 1907, being date of application in Germany.) May 1st. (Complete.)

9,481. "Improved system of heating by electricity and apparatus for use in connection therewith." T. J. Rorke and E. Rorke. May 1st. (Complete.)

9,501. "Improvements in electric arc lamps." H. Baggett. May 1st. (Complete.)

9,502. "Improvements in and relating to arc lamps." Allgemeine Elektricitäts Ges. (Date applied for under Sec. 91 of the Act, May 2nd, 1907, being date of application in Germany.) May 1st. (Complete.)

9,509. "Improvements in electric switches." J. Miles. May 1st. (Complete.)

9,518. "Improvements in the electrical transmission of half-tone or line photographs." T. T. Baker. May 2nd.

9,537. "Improvements in and relating to metallic fittings for electric continuity system." C. Vaughan and C. Birch. May 2nd.

9,546. "Improvements relating to alternating electric current induction motors." M. Walker. May 2nd.

9,552. "Improved electrical block signalling apparatus for railways." G. H. Brown. ((Date applied for under Rule 13, May 8th, 1907. An invention comprised in application No. 10,687 of 1907. Application for Patent of Addition to No. 2,413/1907.) May 2nd.

9,569. "Improvements in or relating to electric wire poles or masts." J. Jaeger. (Date applied for under Sec. 91 of the Act, May 8th, 1907, being date of application in Switzerland.) May 2nd. (Complete.)

9,571. "Improvements in an electrical locomotive signalling device with automatic control of the steam whistle, and of the continuous brake." J. Kordin. May 2nd. (Complete.)

9,577. "Improvements in and relating to dynamo-electric machines." Allgemeine Elektricitäts Ges. (Date applied for under Sec. 91 of the Act, May 4th, 1907, being date of application in Germany.) May 2nd. (Complete.)

Water Power in Russia.—It is reported from St. Petersburg that a syndicate of Belgian capitalists proposes to utilise the power of the Borowit waterfall, which is situated between Moscow and St. Petersburg, for the purpose of the production of electrical energy for the supply of these two cities and for the working of the Nikolai railway. The plans have already been prepared, and application for a concession will shortly be made to the authorities.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1906.

Electrically-Operated Locks and Fastenings. E. Burns. 26,560A. (Date applied for under Rule 13, May 21st, 1907.)

1907.

Ignition Devices for Blasting and Mining Fuses. A. F. Hargreaves. 13,880. June 15th.

Indicators or Annunciators. W. A. Hildyard. 15,224. July 2nd.

Fire Indicators or Alarms. C. Smith. 15,770. July 9th.

Electrically-Operated Fountains. A. D. Southam. 17,147. July 26th. (Date applied for under International Convention, August 4th, 1906.)

Electric Arc Lamps. A. D. Jones. 17,781. August 3rd.

Electro-Magnetic Reversing Coupling. F. M. Meyer. 17,783. August 3rd.

Manufacture of Electric Incandescent Lamps having Filaments made from a Plastic Mass. Siemens & Halske Akt.-Ges. 17,973. August 7th. (Date applied for under International Convention, August 28th, 1906.)

Locking Apparatus for Locking Electric Light Glow Lamps to Holders. W. J. Bodell. 1?,083. August 8th.

Electric Switches. J. W. Ewart. 18,406. August 14th.

Electrolytic Process for the Preparation of Indigo Dyes. H. Chaumat. 19,027. August 23rd. (Date applied for under International Convention, August 28th, 1906.)

Electric Striking Mechanism for Time-Pieces. M. Moller. 21,623. September 30th.

Telephone Exchanges. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 22,745. October 15th.

Alternating-Current Commutating Electric Machines. Allgemeine Elektricitäts Ges. 24,135. October 31st. (Date applied for under International Convention, November 1st, 1906.)

Insulated Railway Rail Joints. B. Wolhaupter. 24,769. November 8th (Date applied for under International Convention, November 8th, 1906.)

Vertical Motors. L. Bollee. 25,430. November 16th. (Date applied for under International Convention, November 19th, 1906.)

Insulated Railway Rail Joint. B. Wolhaupter. 25,832. November 21st.

Insulated Railway Rail Joint. B. Wolhaupter. 25,839. November 21st. (Date applied for under International Convention, December 6th, 1906.)

Receiver Arrangement for Wireless Telegraphy. Ges. für Drahtlose Telegraphie. 26,531. November 30th. (Date applied for under International Convention, December 3rd, 1906.)

Electric Alarm Clocks. F. H. Palmer. 26,647. December 2nd.

Method of Ensuring Insulation of the Current Conducting Parts of High-Tension Magneto-Electric Sparking Apparatus. G. A. Unterberg and F. Helmle, trading as Unterberg & Helmle. 26,925. December 5th.

Electrical Locking Apparatus for Railway Signals. J. A. Hoffe and G. H. Jelfs. 28,212. December 21st.

Production and Maintenance of Interrupted Electric Arcs of High Frequency. E. Ruhmer. 539. January 8th.

Method of Effecting Hertzian Telephony and Apparatus therefor. E. Ruhmer. 3,215. February 8th.

Electrical Ignition Apparatus for Use in Internal-Combustion Engines and for other Purposes. A. J. Postans. 5,194. March 4th.

Method and Means of Radio-Telegraphy and Radio-Telephony. J. H. Webb. 7,687. April 2nd.

Electric Arc Lamps. H. Bevis and A. E. Angold. 7,941. April 5th.

Electric Arc Lamps. H. Bevis and A. E. Angold. 7,941A. April 5th. (Date applied for under Rule 13, April 5th, 1907.)

Electric Automatic Fire Alarms. H. Howson. 7,959. April 5th.

Alternating-Current Dynamo-Electric Machines. R. D. Mershon. 8,183. April 8th.

Receivers for Wireless Telegraphy. Ges. für Drahtlose Telegraphie. 8,364. April 10th. (Date applied for under International Convention, April 10th, 1906.)

Process for the Manufacture of Metallic Illuminating Bodies Adapted for Electric Incandescence Lamps. Deutsche Gasglühlicht Akt.-Ges. (Auergesellschaft). 8,563. April 13th. (Date applied for under International Convention, August 30th, 1907.)

Joints between Incandescent Electric Lamp Filaments and Leading-In Wires or Supports. British Thomson-Houston Co. (General Electric Co., United States.) 8,641. April 13th.

Electric Lamp-Holder Applicable for Motor Carriages and the like. J. Davis. 8,903. April 17th.

Electro-Magnetic Circuit Breakers. Electric & Ordnance Accessories Co. and R. F. Hall. 9,868. April 29th.

Electrical Messenger Call and Order Installations. Siemens Bros. and Co. and G. S. Grimston. 11,381. May 15th.

Electric Sign Switches. A. Botting and W. H. Botting. 11,850. May 22nd.

Mechanism for Operating Magneto Machines. S. Griffin. 12,402. May 29th.

Dynamo-Electric Machinery. Lancashire Dynamo and Motor Co. and W. Stansfield. 12,420. May 29th.

Electrical Counting and Indicating Gear. L. Newitt. 12,907. June 4th.

Receiving Apparatus for Wireless Telegraphy. Marconi's Wireless Telegraph Co. and C. S. Franklin. 12,960. June 4th.

Electrical Signalling Apparatus. E. E. Moore and W. Powles. 14,150. June 19th.

Electric Light Carriers or Fittings. H. M. Appleyard and E. Quiggin 16,383. June 17th.

Manufacture of a Plastic Mass from Tungsten Compounds. Siemens and Halske Akt.-Ges. 16,489. July 18th. (Date applied for under International Convention, July 21st, 1906.)

Apparatus for Cooling Electric Machinery. W. L. Wise. (C. O. Mailloux, United States.) 16,513. July 18th.

1908.

Electric Lamps for Miners' Helmets and the like. J. H. Drager and A. B. Drager. 559. January 9th.

Socket Shells Suitable for Holders for Electric Lamps. H. Hubbell. 879. January 14th.

Holders for Electric Incandescent Lamps. A. Loebl and British Ever-Ready Electrical Co. 2,676. February 6th.

Production of Powerful Interrupted Electric Impulses of High Frequency. E. Ruhmer. 7,041. March 30th. (Date applied for under Rule 13, January 8th, 1907.)